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MEMOIR

ON THE

PALAEOZOIC RETICULATE SPONGES

CONSTITUTING THE FAMILY

DICTYOSPONGIDAE

BY

JAMES HALL

STATE GEOLOGIST AND PALAEONTOLOGIST

IN COLLABORATION WITH

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PREFACE.

This Monograph of the DICTYOSPONGIDÆ is the conclusion of an undertaking, the inception of which is indicated by my publication upon these fossils in 1884. Up to the year 1863, only occasional expressions had been made with reference to the nature of such bodies; first, by Mr. T. A. CONRAD, after the close of his connection with the Geological Survey of the State and, again, in the same year (1842), by Mr. LARDNER VANUXEM, in his final report on this Survey. The specimens which came under the notice of these observers were as widely unlike as the limits of the family permit, and while CONRAD considered his specimen, HYDNOCERAS, a cephalopod, VANUXEM regarded the form described by him, UPHANTÆNIA, as a marine plant. In my paper of 1863, I was disposed to accept VANUXEM's views of these bodies as nearer the truth.

In the years which intervened, from 1863 to the date of publication of my second paper, in 1884, specimens had begun to accumulate in the collections of the State Museum, and toward the latter part of this period especial efforts were made to gather material that would justify a more thorough study of the subject, though little anticipating that it would ever assume the comprehensive proportions with which it appears to-day. While new material was gradually being acquired from the Chemung rocks of this State, as one result of the activity of collectors sent out on behalf of the Palaeontology of New York, additional forms were obtained from the Waverly sandstone of Ohio, during the survey of that state by the late Dr. J. S. NEWBERRY; and admirable specimens were being found in the calcareous shales of the Keokuk group at Crawfordsville, Indiana. It was the acquisition and study of this last named material, that led to the determination by Mr. R. P. WHITFIELD, in 1881, of the spongous nature of these fossils.

In order to show the progress which had been made in the study of these organisms, I issued in 1882, four large octavo plates of figures with explanations and, in 1884, reproduced these plates with a brief descriptive account of the fossils illustrated. In 1890, an addition to the known species was made by the publication (though without illustrations) of a group of Chemung

species, a paper prepared at my request by Mr. JOHN M. CLARKE. With this publication, forty-two species of these sponges had been described from the palaeozoic rocks of the United States.

So rapid has been the growth of these collections and so generous the disposition of all collectors and students toward the perfecting of this monograph, that to-day we present descriptions of about thrice the number of specific forms recognized as such, seven years ago. This wonderful increase is not especially a matter for congratulation, save that it serves to show the amazing diversity of these siliceous sponges in late Devonian and early Carboniferous faunas. The species and genera are established in accordance with the best standards attainable for these variable organisms. Future collections and observations may show that these divisions are not in all cases sharply defined; they will undoubtedly show that the present account of this organic element in these ancient rocks is far from being complete.

In 1892, Mr. CLARKE undertook a revision of all previous work upon these fossils and this, with the elaboration of new material, he has carried forward to its present state.

During the preparation of the work, many favors have been shown by geologists and others having specimens of DICTYOSPONGIDÆ in their collections. Acknowledgments are due to them all, but our obligation to some requires particular mention.

This monograph could never have been made what it now is, were it not for the enthusiastic cooperation of Mr. EDWIN B. HALL, of Wellsville, N. Y. Mr. HALL has demonstrated a wonderful abundance of the DICTYOSPONGIDÆ in the upper Chemung rocks of New York. His collections, which are constantly growing under his zealous explorations, are remarkably rich in this material and have been at all times accessible for use in this work. It is to be remarked, with some regret in view of the issuance of this book, that Mr. HALL's more recent collections afford evidence that as yet we are far from having a full representation of the hexactinellid sponge fauna of this geologic period, notwithstanding that more than sixty species of this ancient date are here illustrated. With our present knowledge, the middle and upper beds of the Chemung group in Allegany and Cattaraugus counties appear to have been the seat of extensive sponge plantations, more prolific in diverse forms and individuals than the region immediately to the east and west. This impression may, however, be a mistaken one and due to the fact that Chautauqua, Chemung and

Broome counties have yet to be as carefully explored for these fossils as have been Allegany, Cattaraugus and Steuben counties.

To the late Reverend JONATHAN ALLEN, former president of Alfred University at Alfred, Allegany county, an early and interested collector of these sponges, I owe many favors. From him, by loan and purchase, I obtained some interesting specimens, and at one time employed his son to make collections from the localities in and about Alfred.

Mr. D. DANA LUTHER, both before and during his engagement upon the geologic work of this department, has supplied a number of interesting forms from the lower beds of the Chemung group in Ontario, Yates and Steuben counties, and has recently discovered DICTYOSPONGIDÆ in some variety in the shales and sandstones of the Portage group, in Wyoming and Ontario counties; a formation from which they had not been previously obtained.

As early as 1883, Professor CHARLES BARROIS, of the University of Lille, demonstrated the existence of DICTYOSPONGIDÆ in the Psammites du Condroz of Brittany. The forms which were described by him are noteworthy in their similarity to those occurring in our equivalent geologic horizon, the Chemung group. Professor BARROIS, with most courteous liberality, has placed these specimens, together with some later collections from the same horizon, in my hands for comparative study, with full permission to illustrate and describe them. As no other part of the world has yet furnished species so closely allied to the American Dictyosponges, we have gladly availed ourselves of this privilege and these French species will be found fully described and illustrated in this volume.

Further,—to the following gentlemen and institutions, acknowledgment is here made for their courtesy in the loan of specimens.

Sir WILLIAM DAWSON, of Montreal, whose important descriptions of various beautiful forms of PROTOSPONGIDÆ from the slates at Little Metis are well known, and who has kindly loaned a nearly complete series of his species for comparative study.

Mr. A. S. TIFFANY, of Davenport, Iowa, for the loan of specimens from Crawfordsville, Indiana, representing the new genus LEBEDICTYA, and specimens of CLATHROSPONGIA both from the locality mentioned and from the Waverly group of Ohio.

Mr. J. F. CARLL, of Pleasantville, Pennsylvania, who has supplied specimens from the lower Carboniferous rocks of Pennsylvania, upon which we have established the species *Calathospongia Carlli*.

Through the kindness of Prof. I. C. RUSSELL, of the University of Michigan, was obtained the use of the original specimen of *Lyrodictya Romingeri* and a few others belonging to the museum of that institution.

From the American Museum of Natural History, through Prof. R. P. WHITFIELD, was received on loan all the material representing the DICTYOSPONGIDÆ in the Hall collection together with that utilized by this author as the basis of his published determinations.

Through Prof. J. F. KEMP, of Columbia University, the specimens from the lower Carboniferous rocks of Ohio, collected by the late Dr. J. S. NEWBERRY and belonging to the museum of that institution, were kindly loaned.

Interesting specimens from the Chemung and Waverly groups, which have been utilized in our illustrations, were obtained from the Peabody Museum of Yale University through the favor of Prof. C. E. BEECHER.

Some important specimens from the Utica slate, fully discussed herein, have been received from the National Museum at Washington, by the courtesy of Mr. CHARLES SCHUCHERT and the late Dr. G. BROWN GOODE.

Prof. ALBERT A. WRIGHT, of Oberlin College, generously loaned specimens from the collections of that institution, among them a very large and interesting example of the rare genus HYPHANTÆNIA.

Through the favor of Prof. E. W. CLAYPOLE, of Akron, Ohio, was obtained the original specimen of *Cleodictya Claypolei*.

The Rev. J. H. MCKEE, of Olean, has permitted the examination and use of Chemung sponges in his own collection and that of the Olean Society of Natural Science.

The delineation of the accompanying figures has been largely done by Mr. GEORGE B. SIMPSON, who has produced them in a highly skillful and artistic manner. Some of the earlier figures were made by Mr. EBENEZER EMMONS. The illustrations of spicules are from camera drawings by Mr. CLARKE.

The lithographic work has been admirably executed by Mr. PHILIP AST.

In the correction of the proof sheets much assistance has been rendered by Mr. JACOB VAN DELOO.

To the persons mentioned and to all others who have been of assistance to the work, I offer the assurance of my obligation and consideration.

JAMES HALL.

Professor JAMES HALL died on August 7th, 1898, at the great age of nearly eighty-seven years. At the time of this lamentable event only a few pages of this memoir had been printed, but his lively interest in the work which owes to him its inception, and his pride in its accomplishment, will always associate his name with present and future knowledge of these remarkable organisms, the DICTYOSPONGIDÆ.

JOHN M. CLARKE.

CONTENTS.

PAGE

Title 1

Preface 3

Contents 9

The Palaeozoic Retiolate Sponges constituting the Family Dictyospongidæ 11

Introductory 13

Preliminary remarks 13

General Observations on the Sponges 14

Anatomy 14

Form 16

Individuality 16

Mode of Attachment 16

The Siliceous sponges. Skeletal structure 17

Taxonomy 20

Symbiosis 21

Affinities of the Dictyospongidæ 22

Family Dictyospongidæ 29

Structure of the Skeleton 29

Variations and Genetic Relations of form 33

Modes of Preservation 36

Habitat and Mode of Occurrence 37

Historical; Bibliography 41

Classification 52

Synoptic List of Genera and Species 54

Tables showing the Geologic Distribution 60–62

Descriptions of Genera and Species 63

Species of the Silurian 63

Species of the Devonian 64

Species of the Lower Helderberg Group 64

Species of the Hamilton Group 65

Species of the Portage Group 68

Species of the Chemung Group 72

Species of the Psammites du Condroz 147

Species of the Carboniferous 151

Species of the Waverly Group 151

Species of the Burlington limestone 165

Species of the Keokuk Group 166

THE PALAEOZOIC RETICULATE SPONGES

CONSTITUTING THE FAMILY

DICTYOSPONGIDÆ.

INTRODUCTORY.

Preliminary Remarks. The purpose of this work is to present an account of some palaeozoic forms of an extinct group of organisms, representing the "glass-sponges" of existing seas. Certain simple structures known as PROTOSPONGIA which occur in the Cambrian and early Silurian faunas, have for many years been looked upon as examples of such siliceous sponges, notwithstanding the fact that their skeletons have been wholly replaced by other substances, but until a comparatively recent period the interesting division of these fossils here designated as a distinct family, was unknown or unrecognized as sponges in palaeozoic faunas. The earliest form recorded was looked upon by its discoverer, Mr. T. A. CONRAD, as a cephalopod shell, and was so described in 1842, under the name *Hydnoceras tuberosum*. This specimen was from the Chemung rocks of Steuben county, N. Y. At the same date, a wholly distinct form from the same geologic formation was described by Mr. LARDNER VANUXEM as *Uphantænia Chemungensis* and was regarded by him as a marine plant. This interpretation of the nature of such bodies became current for the time, and was expressed in the term *Dictyophyton*, which was subsequently applied to several species from the upper Devonian and Waverly horizons. Although the species which had been described up to the year 1880, manifested considerable diversity of form, their condition of preservation did not readily suggest their real nature. In all instances the delicate skeleton of the sponge had been dissolved and had disappeared, leaving only internal and external casts of the bodies with more or less distinct impressions of the spicular network. Such markings were believed to be comparable to those occurring in some of the living marine algae and this similarity, in the absence of any recognized agreement with other known organisms, was the basis of the interpretation of their nature as then made. The discovery of bodies of a similar character in the calcareous shales of lower Carboniferous age at Crawfordsville, Indiana, revealed a spicular skeleton, all the parts of which had been changed to iron pyrites, but were not otherwise materially modified. The study of this material elicited the first definite evidence of relationship of these bodies to

the reticulate siliceous sponges, an opinion which all later investigations have tended to confirm.*

All that is now known with reference to this family of the siliceous sponges, the DICTYOSPONGIDÆ, has been brought together in this volume. The last ten years have vastly increased the number of known forms and demonstrated that in certain late Devonian and early Carboniferous faunas they were abundant in individuals, species and genera. The accounts of the species previously described have been for the most part brief and either insufficiently illustrated or entirely without illustration. In addition to the representation here given of the general aspect of these forms, there is added, where the material permitted, a microscopic analysis of the spicular skeleton.

General Observations on the Sponges.

The Sponges, with the exception of a few forms inhabiting fresh waters, are marine animals, and among the lowest and simplest in the scale of life. Less simple than the Protozoa, they are also of less complicated anatomy than typical Cœlenterata (anemones and corals), and there is an inclination among some later investigators to recognize them as a distinct sub-kingdom of the animal world.

Anatomy. A sponge is an aggregation or colony of simple cells; a mass of connective tissue lined without and within by obscurely differentiated layers. Together, these usually form a sac-like body, attached at the lower or closed end, and to its interior cavity (*paragaster*) the water has free access by means of canals, extending from the exterior surface and opening upon the walls of the paragaster. The course of the water currents is, thus, centripetal over the general surface of the sponge, and centrifugal from the paragaster through the *osculum* or mouth of the sac.

Among the cells of the outer epithelial layer which lines all the canals leading into the internal cavity, are scattered numerous flagellate cells, by the action of whose long "whip-lashes" the flow of nutrient water currents is produced and determined. Such flagellate cells are aggregated in little

* Previous to 1881 there had been only vague suggestions of the sponge-nature of these fossils. The clew to their real character was first furnished by the introduction into the museum collections of this country of the exquisite glass-sponge known as the "Venus flower-basket" and described by the late RICHARD OWEN as *Euplectella aspergillum*. Although this description dates as far back as 1841, the species was a very great rarity in collections here until fifteen or twenty years ago. About that time the sponge fishers of the Philippine Islands, the seas of which are the favorite habitat of the species, glutted the market, so that in England, according to Sir WYVILLE THOMSON, the price of good specimens fell at once from five pounds to ten shillings or less (*The Atlantic*, p. 136, 1878).

chambers within the fleshy part of the sponge wall; to them run the inhalent canals (*epirrhysa*) from the external surface of the sponge, and from them depart the exhalent canals (*aporrhysa*) emptying into the paragastral cavity, through apertures termed *ostia*. All skeletal structures belong to the connective tissue, that is, the median layer.

Such, in brief, is the essential structure of the typical sponge, and from this type there are no departures so extreme as to obscure comparison with this standard. In the simplest sponges, as the *Ascones*, the wall is thin and there are no special chambers where the ciliary cells are aggregated. The entire surface of the paragaster, however, is covered with these flagella. It seems highly probable that a similar condition prevailed among the ancient thin-walled hexactinellids, which are here under consideration. SCHULZE states that while he could not determine the existence of flagella in the hexactinellids on account of the smallness of the cells, he believes that they exist. (Challenger Expedition, *loc. cit.* p. 23.)

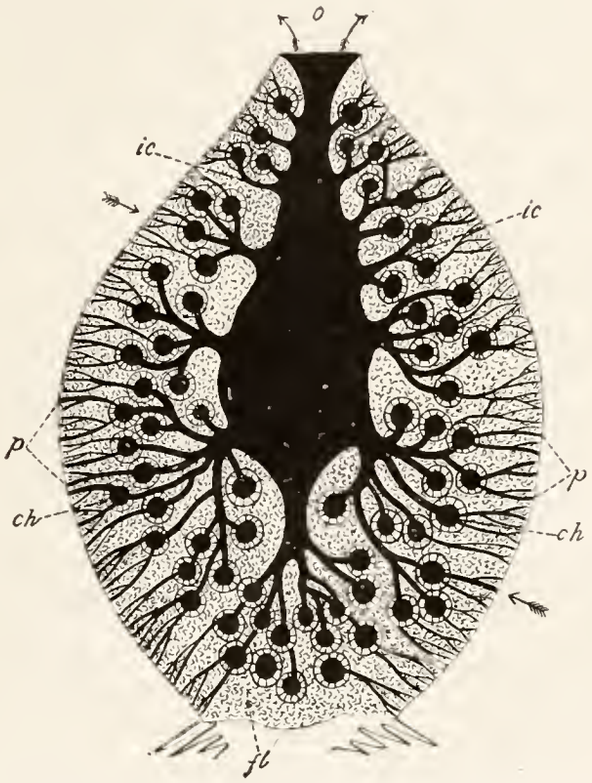

FIGURE 1. Diagrammatic figure showing the structure of a simple sponge in vertical section. The sponge substance (*fl*) is lightly shaded. The canal system is black, the arrows showing the direction of the currents. *pp*, are the pores or openings of the inhalent canals (epirrhysa) which lead to the flagellate chambers, *ch*. From the latter depart the exhalent canals (aporrhysa), *ic*, which open into the general central cavity or paragaster. *o*, is the osculum or aperture through which the water is discharged. (HAECKEL.)

Fixation is an not invariable character. There are, for example, certain ball-shaped lithistid sponges, like the palaeozoic ASTYLOSPONGIA and HINDIA, which appear to have been unattached and the sport of the water currents. These sponges, too, as well as others which are attached, present a concentric arrangement of the water canals which, according to RAUFF, have originated from the ramified furrows of the external surface and have eventually become internal by progressive over-growth of the sponge in concentric layers. Such concentric canals parallel to the periphery of the sponge, are simply large conduits receiving the external water through a great number of minute, converging epirrhysa and debouching in the small paragaster near the summit of the sponge.

Form. Sponges assume an endless variety of expressions of a sac-shaped body. Aside from inherent specific traits, which express themselves most forcibly in such variations, there are numerous external conditions which superinduce modifications in form, even within the limitations of a species. Irregularities in growth may arise from the sponge receiving more nutriment on one side than on the other, and differences in the aspect of individuals belonging to the same species are found to be due to the fact that some have grown in quiet waters and others where the water was in motion. The existence of such variability, which is corroborated by living sponges, can not fail to embarrass the discrimination of specific values among fossil forms. The Dictyosponges present some interesting examples of such *polytrope* species. The *Hydnoceras tuberosum*, Conrad, is a vase-shaped, sub-prismatic sponge, with several horizontal rows of strongly tufted and pointed nodes, and all Dictyosponges having these characters might very conveniently be referred to this specific type. We know, however, the location of several plantations or colonies of these sponges on the sea-bottom of the Chemung period, and have endeavored to make it apparent in the ensuing descriptions, that in each of these colonies the individuals have an expression which characterizes the members of that colony alone. These are distinctly local expressions, due to restricted variability, and they serve to indicate in several instances, the precise spot where they have grown.

Individuality. Sponges may assume either a simple or a compound form; growing as a single sac which never branches or divides, or as a bush-like stock increasing its branches by the production of buds. The compound mode of growth is rare among the siliceous sponges and there is no satisfactory evidence that in the family DICTYOSPONGIDÆ there was ever a tendency to duplication of the sponge by budding. The species *Mastodictya osculata*, of the Keokuk shales, requires further investigation in this respect, as it is not well understood. But as a whole these ancient sponges have rigorously maintained their individuality, so far as that term is permissible in application to a single skeletal structure.

Mode of attachment. The vast majority of all sponges, recent and extinct, have a portion of the body more or less distinctly specialized for fixation. This attachment may be to solid extraneous bodies, rocks, pebbles, dead or living shells, or may be effected by the simple penetration of muddy or sandy sediments by the long, stout fibers of the skeleton.

Reeent species and the later fossil forms show that fixation may be effeeted either by the base (*basiemphytic*) or by one side (*pleuremphytic*) of the sponge. The ancient sponges were largely, indeed almost exclusively basiemphytic. This term, however, is quite general, as basal attachment is effected by several special appliances (*lophophytes*). Some basiemphytic sponges spread their substance over the opposing surface so that the basal part may be of greater diameter than the superior portions of the sponge and show no difference therefrom in spicular composition. In others, such as Polylophus, tufts of spicular threads from the lateral lobes curve downward, and are interwoven into a short basal rope; while in Pheronema attachment is attained by means of several distinct basal tufts. In Euplectella the strong vertical threads of the skeleton terminate below in a tuft of fibres which constitutes the tip of the elongate obconical body. Hyalonema possesses a long twisted rope of thick strands, Holascus and Dictyospongia have shorter, untwisted basal bundles. In Thysanodictya and Phragmodictya attachment was effeeted by means of a frill or collar (*periloph*) encircling the truncated base, and in the latter genus appearing to have been aided by a small tuft extended from the basal diaphragm. The Devonian Dictyosponges, Hallodictya, Actinodictya and Cryptodictya, were either spreading forms enerusting the surface upon whieh they grew, or pleuremphytic sponges attached by specialized processes yet unknown. There are many forms among the Dictyosponges whose mode of life must have been like that of Euplectella, buried in the mud or sand for a considerable portion of their length. Such are Dictyospongia and the long, slender, annulated horns of Ceratodictya.

The composition of the sponge-skeleton is generally regarded as of fundamental significance in the classification of the entire division, and the combination of the skeletal elements, the shape of their component parts and their mode of union, are highly essential taxonomic characters. The proper understanding of the fossil sponges is, therefore, greatly embarrassed by the usual mutilation and destruction of the skeletal parts, or their modification by the process of fossilization. This knowledge can be acquired only by most patient investigation of the best preserved material.

Since this work does not deal with the ceratose or calcareous sponges they may be left out of present consideration.

The Siliceous Sponges — *Skeletal Structure.* The structure of the siliceous sponges is simple, though often difficult to elucidate on account of the isolation of a part or all of the spicular elements. The siliceous sponges are either thick or thin-walled. In the former the considerable substance of the cup permits a full development and differentiation of the external, medial

and internal parts of the skeleton, while in the thin-walled sponges these different parts are necessarily condensed, and probably abbreviated or only partially developed. Thick-walled siliceous sponges are not of infrequent occurrence in the earlier faunas, but all the DICTYOSPONGIDÆ and their most closely allied groups, possessed a very thin, almost lamellar skeleton in which a distinction between the dermal and gastral surface is not always clearly perceptible. The accompanying figure which is adapted from one by F. E. SCHULZE, will convey a conception of the disposition of the parts of the skeleton in the thick-walled siliceous sponges. It may be presumed that a

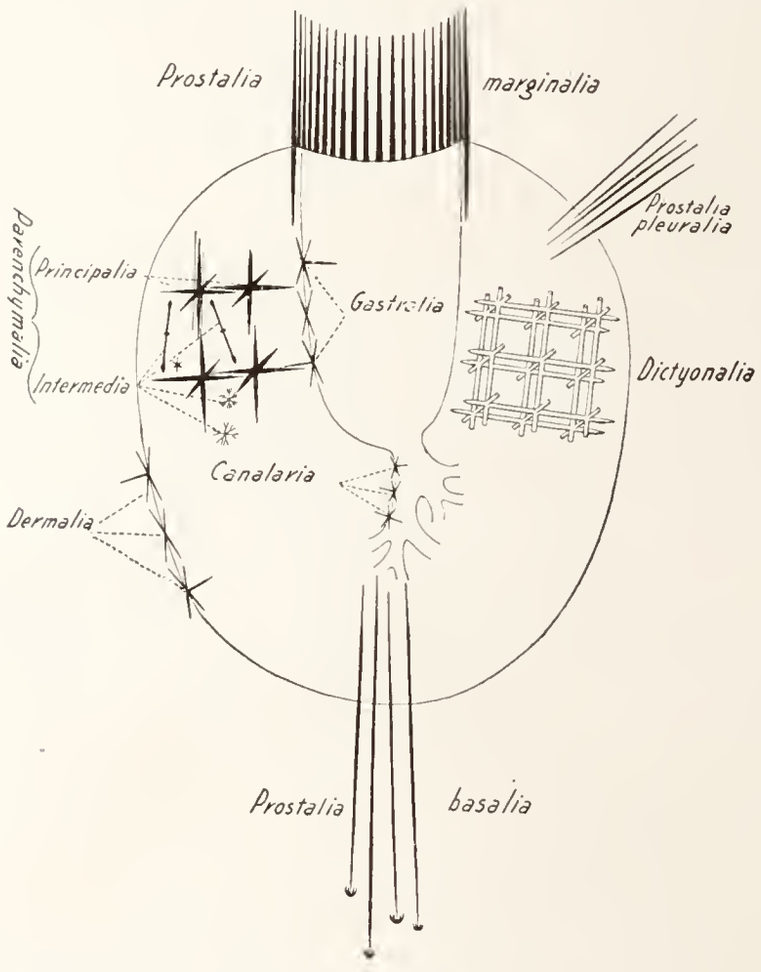

FIGURE 2. Diagram of arrangement of the spicules in the Hexactinellida. (SCHULZE.)

corresponding relation of parts exists in the thin-walled sponges but it is not often possible among the fossil species to distinguish the precise position of the isolated spicules in the skeleton. The most conspicuous and strongest parts of the skeleton are the long rods or smooth spicules projecting from the surface of the cup. These are known as the *prostalia*. They may form a root-tuft at the base of the cup (*basalia*) as in many species both of fossil and living forms, and in such cases they are sometimes furnished with a means of attach-

ment to the sediment in the form of a minute anchor at the extremity of each rod. Such root-spicules are not always present but it would seem that in most of the DICTYOSPONGIDÆ they have been more or less highly developed. About the aperture or osculum there may also be a series of *prostalia*, known as the *marginalia*, which may be present or absent in the thin-walled sponges. At intervals over the lateral surface of the sponge there may be tufts of *prostalia*, such as frequently occur in the DICTYOSPONGIDÆ; these have been termed *pleuralia*. The DICTYOSPONGIDÆ in common with the closely allied family EUPLECTELLIDÆ, also possess horizontal and vertical series of smooth rods in bundles of greater or less size. These cross each other at right angles and produce a reticulated surface which is a leading characteristic of the entire group. The regularity and uniformly descending order of this reticulation is a marked character of these sponges. The regularity of the meshes is, indeed, a feature shared with the PROTOSPONGIDÆ, but in that family there is no such multiplication of the meshes by subdivision as occurs in the Dictyosponges. Though this gradually descending subordinate reticulation is seen in all true members of this family, it has not been determined that the descending series of intersecting spicular bundles which produce the mesh-work are always of a definite number. If, in non-prismatic species, the uniformly largest prevailing quadrule be fixed upon as that produced by the primary spicular bands (THYSANODICTYA, CLATHROSPONGIA) or, in prismatic forms, by the bands lying on the prism angles and intersecting with equidistant horizontal bands (PRISMODICTYA, HYDNOCERAS), it is found that there is a sub-division of the primary quadrule, or *mere*, to the fifth degree; that is, there is a descending series of six sets of reticulating bands, forming quadrules which, in terms of the primary quadrule, or mere, may be designated as *dimeres*, *trimeres*, *tetrameres*, *pentameres* and *hexameres*. Only in rather unusual instances of delicate preservation are the ultimate quadrules, or hexameres, retained. Such reticulation is a quite uniform character of the majority of the genera of these sponges, but there are instances, seen in such genera as PHYSOSPONGIA, ROEMERISPONGIA and HYPHANTÆNIA, in which the uniformity of this gradation is lost; and where there is a single or double series of major quadrules whose surface is covered by an exceedingly minute reticulation (PHYSOSPONGIA) or, possibly, by none at all (ROEMERISPONGIA, HYPHANTÆNIA).*

*The fine reticulation of the major quadrules in PHYSOSPONGIA seems, as elsewhere observed, to be due not to intersecting spicular threads or bundles, but largely to regularly arranged hexactins of the parenchyma; while there are good reasons for regarding the apparently uncovered quadrules in ROEMERISPONGIA and HYPHANTÆNIA as due to the imperfect retention of this delicate layer.

The fossil species show that these fascicles of rod-like spicules lie upon the paragastral surface and a given spicule is often continuous from one extremity of the sponge to the other. It seems evident that these spicules have no connection with the *basalia* and *marginalia*, though the latter are continued into the substance of the sponge and may extend through to the paragastral surface. In the living EUPLECTELLA, the ground work of the skeleton is of similar character, and students are generally agreed in regarding the cylindrical rods composing the horizontal and vertical bundles as modifications of cruciform spicules, due to extreme prolongation of the rays of one axis and the complete suppression of the others. In the Dictyosponges these fascicles sometimes include rods terminating in anchors, and others with a series of barbs along the sides (*clemes*); a fact which may tend to corroborate the derivation above assumed. Under this interpretation these rod-like spicules are of different nature from the *prostalia*; as they are evidently gastral in position they are properly termed *gastralia* and may be distinguished from less modified gastral spicules lying in the interspaces of the network by the term *gastralia lateralia*. Such rod-shaped spicules when clearly preserved in pyrite show very distinctly a tubular axial cavity about which the substance of the rod is arranged in concentric bands or envelopes. Other spicular elements of the Dictyosponges such as have been clearly made out, can be referred to the outer surface of the cup (*dermalia*) and there are a few which it may be safe to regard as representing the medial layer or parenchyma of the thick-walled sponges (*parenchymalia*). The variations in the spicular composition of the skeleton will be considered at greater length in following pages.

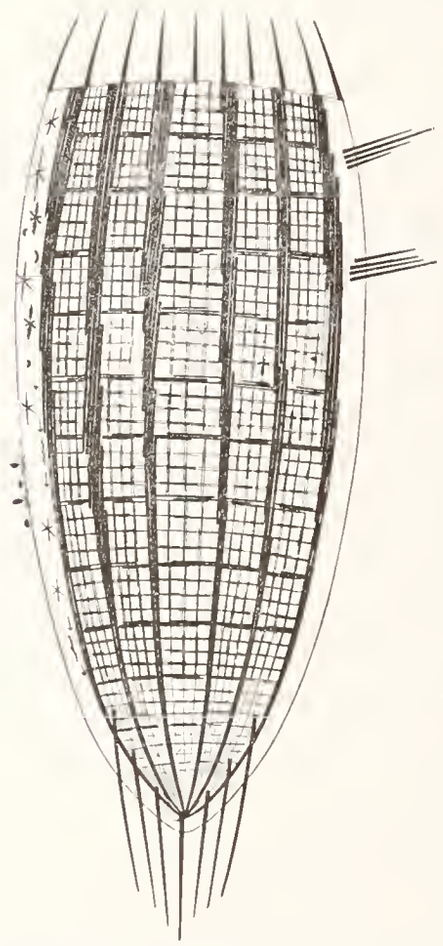

FIGURE 3. Diagrammatic representation of the arrangement of the spicular parts in a typical Dictyosponge.

Taxonomy. The siliceous sponges constituting the Class SILICEA, (GRAY, 1867), or those whose skeleton is essentially composed of siliceous spicules*, are divided into three orders, based upon the form of the

*Recent writers (cf. RAUFF, *op. cit.*) include in the *Silicea*, the ceratose or horny sponges.

fundamental spicule in each. These are the (1) **Hexactinellida**, (2) **Tetractinellida**, (3) **Monactinellida**; in which the predominating spicule, whether its form be unmodified or derived, has respectively six rays, four rays and but a single ray.

In the **Hexactinellida** (OSCAR SCHMIDT), the normal form of the spicular element is a six-rayed star whose rays are of equal length and lie in three planes at right angles to one another. These spicules are termed, with reference to the rays, *hexactins*, or referring to the three mutually perpendicular axes, *triaxons;* from the latter term the name *Triaxonia* was applied to the order by SCHULZE. The variations in the form of the normal hexactins are manifold, spicules with five, four, three and two rays being not infrequent, but it is believed that all are derivatives from, or modifications of, the triaxial type.* These spicules are either isolated and independent, lie side by side forming fascicles, or are coalesced at their extremities forming a continuous network. Two important subdivisions of this order have been generally recognized, (1) the **Lyssacina** and (2) the **Dictyonina**. The former is characterized by the isolation of the spicules which are held together only by the sarcode of the sponge or, in rare instances, by a loose and irregular deposit of siliceous matter; in the latter every arm of each hexactin is united with the corresponding arm of an adjacent spicule, the skeleton thus formed consisting of a frame-work with cubical meshes.

The forms here embraced under the designation DICTYOSPONGIDÆ belong wholly to the suborder *Lyssacina*. So far as their spicular skeletons have been ascertained they afford no evidence whatever of the continuous network which characterizes the *Dictyonina*.

Symbiosis. Very interesting instances of commensalism occur in some of the living hexactinellids. A well-known case is that of the gorgonian coral, *Palythoa fatua*, which encrusts the glass rope of HYALONEMA. Another is that of the crab inhabiting the paragastral cavity of EUPLECTELLA, in which it is imprisoned by the reticulum. As it is stated that the terminal sieve-plate is not developed in the early stages of EUPLECTELLA, the crab evidently spends only a portion of its existence thus incarcerated. In regard to this commensal, J. E. GRAY has written:† "The crab is generally found in the cavity of the sponges. The Spaniards in Manila regard them as formed by the crabs for their protection and they do not consider a specimen perfect unless a crab is contained therein. I have, within the last few days had a pair offered to

*See RAUFF, *op. cit.* p. 187; THOMSON, *The Atlantic*, vol. 1, p. 141; and others.
†Annals and Magazine of Natural History, 3d ser. vol. 18, p. 489, 1866.

me for an extravagant sum (£200), because they contained the crab that formed them." Sir WYVILLE THOMSON relates similar facts * and adds: "It is singular that while *Polythoa fatua* is as constantly associated with examples of HYALONEMA from the coast of Portugal as with those of Japan, no commensal crustacean has been found in any of the Atlantic specimens of EUPLECTELLA." DÖDERLEIN has described † a Japanese lithistid sponge having a surface covered with small protuberances within each of which dwells a cirripede of the genus ACASTA. The little crustacean communicates with the outer world through a small opening in the reticulum which is closed at its death.

Among the DICTYOSPONGIDÆ we have observed several instances of vermiform tube-fillings complicated with the impressions of the reticulum and distinctly pronounced on the internal casts of the sponges. These tubes are shown in the figure of *Hydnoceras tuberosum*, var. *glossema*, on Plate IX (fig. 2), and in the illustration of *Prismodictya telum*, on Plate XVII (figs. 3, 9, 10). In all probability these markings indicate the presence of an annelid symbiotic with these sponges.

Affinities of the Dictyospongidæ.

In seeking a proper definition of the family DICTYOSPONGIDÆ, it is necessary to consider its relations to, and differences from the other admitted families of the Lyssacine sponges. On account of the insufficiency of knowledge concerning the spicular structure of these fossils, but few serious attempts have been made to establish their systematic position. HINDE, in 1883, regarded them as *Dictyonina*, and placed the genus DICTYOPHYTON in the family STAURODERMIDÆ;‡ in 1887,§ he included that genus in his proposed family PROTOSPONGIDÆ. These opinions were, however, based upon internal sandstone casts in which all traces of the spicular elements had been obliterated.

RAUFF has defined the family very satisfactorily,¶ placing it among the *Lyssacina*. His characterization of it is in the following terms: "Funnel-shaped, cylindrical or prismatic sponges with thin walls, often raised into nodes or ridges; skeleton very regularly reticulated, forming, as in the PROTOSPONGIDÆ, quadrate or sub-quadrate meshes of different series, enclosing one another. The frame-work is composed of bundles of fine spicules, but whether these spicules are stauractins ‖ with their rays lying

* The Atlantic, vol. 1, p. 141, 1878.

† Zeitschr. für wissensch. Zoologie, vol. xl, 1840. See also RAUFF, Palaeospongiologie, part 1, p. 140.

‡ Catalogue of the Fossil Sponges of the British Museum, p. 130, 1883.

§ Monograph British Fossil Sponges, p. 90.

¶ Palaeospongiologie, p. 189, 1893.

‖ The terms "stauractins" and "cruciform spicules" are used interchangeably for any hexactine spicules showing evidence of branches.

close together, or are diactine rods (with triaxial foundation), or a combination of both, is not yet certain. Very small but distinct stauractins are present. [Sometimes with terminal sieve-plate (?)]." Although the characters of the family can now be stated with greater precision, still the above definition serves to indicate the structural features which distinguish this from other groups of Lyssacine sponges.

The family PROTOSPONGIDÆ, founded by HINDE and somewhat restricted by RAUFF, includes a number of Cambrian and lower Silurian forms (PROTOSPONGIA, Salter, DIAGONELLA, Dawson, PHORMOSELLA, Hinde), in which the very thin net-work consists almost exclusively of a single layer of cruciform spicules which lie at the angles of the quadrate meshes, their rays forming the sides of the meshes, but according to RAUFF, not overlapping to form fascicles. In these species all the subordinate series of meshes are similarly formed. In addition to the regular hexactins or pentactins of the reticulum there are also prostalia in the form of a few strong root-threads; sometimes there is a row of short rods about the margin of the osculum. Small lateral surface rods (pleuralia) are also present in some instances. These structures are shown in the species from the Little Metis slates described by Sir WILLIAM DAWSON,* *Protospongia mononema*, *P. tetranema*, *P. coronata*, etc., and it appears from an examination of some of this very interesting material that the cruciform spicules may extend so far as to overlap one another, and also that there are present a few filiform spicules lying along the axes of the stauractins. In some of these sponges, (*Diagonella coronata* and *D. cyathiformis*, Dawson) the meshes are not bounded by vertical and horizontal sides but are arranged in oblique rows. Recognizing these as characters of the PROTOSPONGIDÆ, it seems somewhat difficult to find substantial belief in the usefulness of the proposed family PLECTOSPONGIDÆ, Rauff,† which appears from the description to have for its principal characteristic the formation of spicular bundles by the overlapping of the filiform rays of the stauractins, together with other rod-like spicules. Dr. RAUFF distinguishes in the skeleton a dermal layer which can not be discovered in the PROTOSPONGIDÆ, but is always clearly defined in the DICTYOSPONGIDÆ. CYATHOPHYCUS, its best known genus, also shows evidence of large circular mural openings, as

*New Species of Fossil Sponges from the Siluro-Cambrian at Little Metis on the Lower St. Lawrence; Trans. Roy. Soc. Canada, vol. vii, Sect. iv, pp. 31–55, figs. 1–27, pl. iii, 1889.

†It may be observed that this name has not been formed strictly in accordance with the rules of nomenclature. There is no genus PLECTOSPONGIA and there should not, therefore, be a family termed PLECTOSPONGIDÆ. The type of the family is not specified but it is evident that the *Cyathophycus reticulatus*, Walcott, has furnished the conception of family characters, although the group also includes the genus PLECTODERMA, Hinde.

seen in the figures of the species given on Plate I. They increase the similarity of these sponges to the living EUPLECTELLA, in which such openings are the vacant or unobstructed portions of quadrules formed by the primary pentactins and the rectangular intersection of the spicular bundles, rounded at the angles by the encroachment of irregularly branching filigree work.

The beautiful specimens of CYATHOPHYCUS which have been found in great abundance in the Utica slate at Holland Patent, N. Y., have been the means of affording a pretty clear conception of the structure of this sponge, and the fine figures given by RAUFF, supplemented by those here introduced for comparison with the Dictyosponges, show the details of its composition. Upon consulting figure 10, Plate I, which represents a large and finely preserved example of this species, somewhat conventionally but judiciously restored in parts, it will be observed that the mural openings may be crossed by the larger cruciform spicules of the outer layer (which is not true of EUPLECTELLA), but they are principally outlined by a pyritized film which appears to be spicular, though not readily resolvable. These characters are better shown in figure 12, which is an enlarged view of a portion of another specimen. CYATHOPHYCUS* possesses a tuft of short root spicules, and *Cyathospongia Quebecensis*, Dawson, has been represented as having free prostalia both about the aperture and over the outer surface of the wall.†

Plate I bears a number of figures representing another interesting species from the Utica slate, occurring in association with *Cyathophycus* (*Cyathodictya*) *reticulatus*, in which the mural openings are numerous and very clearly defined, lying on the inner wall of the sponge and being surrounded by a highly irregular network of cruciform spicules. The form and structure of this sponge suggests little relation to *C. reticulatus*, but again illustrates the occurrence of mural areoles which open through the inner wall of the sponge, but are crossed or obstructed by the stauractins of the outer wall.‡

*This name has been hitherto retained although, like DICTYOPHYTON, it tends to perpetuate the old and erroneous conception of the algous nature of these fossils. DAWSON proposed to modify the term to CYATHOSPONGIA, which would have been an appropriate substitute, had not the name already been in use for a genus of thick-walled sponges. CYATHODICTYA would be in better harmony with the terminology in this group.

†After examination of specimens of this species from the Little Metis slates, it seems that the simplicity of the reticulum and the absence of mural openings, ally it more closely with the species which Sir WILLIAM has referred to PROTOSPONGIA, rather than to CYATHOPHYCUS (CYATHODICTYA) which it resembles only in form.

‡Mr. WALCOTT described from the Utica slate (Trans. Albany Institute, vol. x, p. 19, pl. 2, fig. 17, 1879) as *Cyathophycus subsphæricus*, a flattened, subcircular body, showing no structure, except a small area in the center, which was regarded as an aperture. Dr. RAUFF (*op. cit.* p. 256, pl. iv, figs. 3, 4, 1894) has more recently studied these or similar bodies, and figures them as shallow cups with rather thick walls about the osculum. Only traces of the spicular structure were discerned. Although the composition of these sponges is extremely obscure, RAUFF has proposed for the species the new genus TEGANIUM, and is disposed to include under the specific name *Teganium subsphæricum* the form

The presence of mural openings in these members of the PLECTOSPONGIDÆ, is a feature of similarity with EUPLECTELLA and its allies (EUPLECTELLIDÆ), but in none of the DICTYOSPONGIDÆ is there evidence of precisely similar structures. The DICTYOSPONGIDÆ are distinguished from all of these earlier hexactinellids by the presence of an inner wall, composed of strong vertical and horizontal fascicles of rods reticulating at right angles. In the great majority of instances these reticulating bundles are present in a gradational series, the size of the bundle depending upon the number of rods it contains, rather than upon the size of these rods. In normal forms the series of bundles and, consequently, the series of quadrules made by them, numbers as high as five or even six, the finer reticulation of the sixth series being observable only in instances of the most favorable preservation. There are some genera, however, included within the limits of this family, in which there exists but a single set of reticulating bundles. Thus in PHYSOSPONGIA, there

described by Dawson as *Protospongia delicatula*, from the Little Metis slates. In the very extensive material representing the Utica slate sponges which has been under examination in the preparation of this volume, similar obscure bodies have frequently been seen. There are however, associated with them, other spherical sponges, showing very distinctly the composition of the skeleton and presenting some highly interesting characters. These bodies in their adult condition and as usually preserved, appear as illustrated in figure 18 (Plate I), that is to say, they are circular disks undoubtedly representing orginally spherical sponges under compression. In no instance has any trace of aperture been observed. These bodies are so broken by the parting of the shaly laminae that almost invariably a portion of the outer wall of the sphere adheres to one side of the matrix, so that figure 18, which represents the usual condition of the fossil, shows, over the circular central portion, the inner wall of the sponge, the peripheral ring being the thickness of the cup to the outer wall. A good exposure of the outer surface is very rarely seen. The inner surface of the sponge bears a great number of clearly defined areoles or mural openings, which are much more closely arranged than in *Cyathodictya reticulata*, and the network by which they are surrounded is highly irregular, devoid of quadrate meshes, though clearly made up of simple stauractine spicules which are involved in not fully resolvable patches of pyrite (see figures 19 and 20). The thickness of the wall as shown in figures 18 and 22 is considerable, the structure being composed of short rod-like spicules which may all be stauractine and the entering arm of the dermal pentactins, but the specimens do not show this conclusively. An entire layer is formed of a single thin lamina of stauractine spicules making a regular quadrate mesh in which the horizontal rays of the spicules may slightly overlap, but no distinct spicular bundles are formed and no filiform rods are present. A portion of this outer layer is shown in figure 20, traces of the mural openings being seen on the matrix beneath it. The entire outer surface is armed with short, erect spicules. Bodies of this character occur in clusters. One slab measuring 18x8 inches bears twenty seven of them, all of normal size.

The same rock also contains clusters of much smaller circular bodies varying somewhat in size, as shown in figure 16. These also seldom show evidence of an apertnre except such as is seen in one of the larger examples in figure 14, and this appearance may be wholly due to the exfoliation of a fragment of the slate. The substance of the smaller of these spherical bodies or disks is an unresolvable mass of pyrite, of similar character to that described by RAUFF for *Teganium subsphæricum*, except that about the periphery are erect spicules of proportionally much greater length than the surface spicules in the large spheres just described (figure 17). With slight increase in size, however, the spicular skeleton with its mural areoles becomes gradually defined, leading to the conclusion that these *Teganium*-like bodies are young of the larger forms. There is still doubt as to the relation of all of these forms to the *Cyathophycus subsphæricus* of WALCOTT and the *Teganium subsphæricum* of RAUFF.* There is little in their structure to suggest the characters of that species given in the analysis by either of these writers, save the spherical form ascribed to it by the former and the obscure spiculization recorded by the latter, notable only in the very young of our specimens.

The generic characters ascribed to *Teganium* fail to apply to these spheroidal sponges, save in part to their youngest stages, and while we can not be certain that Dr. RAUFF may not have had similar bodies before him in the description of *Teganium*, the uncertainty attending the description and illustration given

is good reason to believe that the quadrules made by the large primary fascicles are not subdivided by similar bundles of less size, although an extremely fine reticulation of these areas may be seen, which may be due to regularly juxtaposed stauractins not on the inner wall, but over the outer surface of the sponge.

In the great saucer-shaped fronds termed HYPHANTENIA (*malé* UPHANTENIA), the broad radial and concentric bands form quadrate areoles which may have been largely or wholly free of spicular structures of any kind. The sandstone matrix in which the few known specimens of this sponge have been found is not favorable for the retention of tenuous spicules, though a similar rock shows at times, the continuity of very fine skeletal films in some other of these sponges. But had there been, over these open quadrules, a coating of fine, isolated dermal spicules, their disappearance rather than their retention would be a reasonable expectation. A single one of the five specimens of HYPHANTENIA at present known, shows traces of such a film at the angles of the great quadrules.

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by him, warrants the application of the term SPHÆRODICTYA to the interesting generic type of structure here analyzed.

*The original specimen of *Cyathophycus subsphæricus* is preserved in the Museum of Comparative Zoology at Cambridge. Like the specimens described by RAUFF it shows no evidence of reticulation or spicular structure, nor are there any traces of peripheral spicules. The central area, supposed to be the osculum, is irregular and there are no means of determining whether it is actually such or is only a casual feature.* Upon application to the curator of the United States National Museum at Washington, for authentic specimens of *Teganium subsphæricum* for comparison with the material above described, we have been kindly allowed to examine a portion of the material studied by Dr. RAUFF and identified by Mr. WALCOTT as his species. Of the specimens received, one is a minute cup-shaped body similar in form to those described by RAUFF and with a similarly obscure skeleton; three others are cups of like form but larger size and with a quadrate network already defined; these resemble young individuals of *Cyathodictya reticulata* and all the rest are the small circular bodies with pseudopodia like peripheral spicules. A portion of a single cluster of these is represented in figure 14, and the enlargement of one of the individuals (fig. 15) shows the clearly defined spicular layer coexistent with the spiny outer wall, while in all the smaller examples the spicules of the skeleton, except those of the outer wall, are not evident. As it was still difficult to apprehend the evidence upon which the determinations made by RAUFF were based, Mr. CHARLES SCHUCHERT, curator of invertebrate palaeontology in the National Museum, was requested to examine the specimens which had been figured by that writer, with especial reference to the following points: (1), Whether the specimens figured by RAUFF in his fig. 4, pl. iv, showed distinct evidence of possessing an aperture, or whether the areas represented as apertures might be exfoliations of the thin pyritized films, (2), whether these three cups are all on the same block and are convex as represented; (3), whether any of these small specimens, when moistened, show a series of peripheral spinules; and (4), whether the larger specimen represented in *op. cit.* fig. 3, has the unresolvable pyrite film and the great aperture, as represented. To these inquiries Mr. SCHUCHERT has, after careful inspection of the material, answered very explicitly: (1), "There is no evidence of an aperture in any of the three small specimens studied by RAUFF. Where these are indicated in the figures there has been a partial or complete removal of the pyritized film in the specimen"; (2), "The three figures given by RAUFF are taken from three separate and distinct specimens so that fig. 4 is ideal. The apertures are drawn in as well as the convexity." (3), "No peripheral spicules can be detected in these specimens." (4), "There is a thin pyritized film which has been varnished over, and in none do I distinguish spicules. The aperture in fig. 3 is also drawn in."

*We have had no opportunity of examining this specimen, but the above statements are based upon an examination kindly made by Prof. ALPHEUS HYATT.

The rods of the vertical and horizontal bundles are for the most part smooth throughout their entire length; they afford no evidence of being stauractine, but, as suggested in the diagnosis of the family given by Rauff, are apparently extremely elongated diactins. The outer wall of these sponges usually carries a regularly quadrate mesh produced by large pentactins standing at each angle of the quadrules. These outer quadrules usually, though not necessarily, correspond with the varying quadrules of the inner reticulum, and it is not at all certain that the outer meshes are greatly subdivided. This outer or dermal layer may also carry projecting spicules of various forms, spinules, umbrella-shaped clavules and echinated stauractins, which will be more fully described in the following pages. The surface may also bear projecting ornamental lamellae and ridges like those in Euplectella, and strongly developed tufts of stout rods, as in Physospongia and Hydnoceras. To the thin space intervening between the outer and inner surfaces of the skeleton are ascribed some normal hexactinellid and minor modified forms of spicules.

The variations in form independent of essential alteration in structure are most noteworthy. Some of the Dictyosponges are obtusely or acutely obconical with a simple exterior; other obconical forms have a highly nodose and tufted surface with, sometimes, clusters of pendulous pouches; many are distinctly prismatic, some bear strong concentric annulations and vertical ridges, a few have the form of large saucers, others of graceful vases with slender neck and expanded bowl, and in two genera the form is almost cylindrical and has a broad fringe or frill about its flattened base.

One should pause to reflect that these ancient organisms with their manifold variety of graceful and striking shapes, were not the sombre bodies we find them to be in the rocks, but in life formed the most delicately woven fabrics of glass, latticed vases, urns and cups of the rarest delicacy and beauty. They must have been, when denuded of their sarcode, among most exquisite structures of the past, as their descendants are of the the present. Nothing for example, could have surpassed the graceful filigreed chalice of *Botryodictya ramosa*, with its slender, tufted pedicel expanding above into a cup ornamented with pendant pouches.

Forms like those just mentioned as having a flattened transverse extremity, raise an important question as to the existence in these sponges of a terminal sieve-plate like that in Euplectella. The determination of this point is essential not only to a proper conception of the limitations of the family

DICTYOSPONGIDÆ, but also to a correct orientation of certain of its members. The genera PHRAGMODICTYA and THYSANODICTYA, which are here fully described and illustrated, are subcylindrical sponges having the margin at one extremity regular, unmodified and free; the other extremity is an almost transverse plate, septum or diaphragm which completely closes the cup, and about its edges where in contact with the walls of the cylinder, is a free expansion or frill. In EUPLECTELLA, which is throughout the nearest living representative of the Dictyosponges, there is, at the *upper* extremity a terminal plate, the so-called "sieve-plate," surrounded by a free marginal frill of spicular net-work.* This terminal portion of the skeleton is, however, less a perforated plate than a combination of stout, inosculating rods or trabeculae. It is described by SCHULZE in the following terms: "The watch-glass-like, arched, terminal sieve-plate consists of a lattice-work of laterally compressed ridges of various thickness, which, though exhibiting no very regular arrangement, yet suggests a wheel-like reticular structure. One can distinguish at least three or four main beams which are approximately circular and several which extend radially. These form the primary meshes, which are again divided by narrower and less prominent ridges. Here and there a broader plate is formed in the net-work, as if by the confluence of the stronger beams."†

This structure is in no respect similar in composition to the net-work constituting the rest of the sponge and its beams are not continuous extensions of the ground-work strands of the latter. It appears to be wholly a protective apparatus for the osculum, cemented to the upper margin of the reticulum. The marginal frill in EUPLECTELLA is simply one of the many surface ridges covering the outer wall of the sponge.

In PHRAGMODICTYA and THYSANODICTYA the structure of the terminal plate is wholly different. It is, primarily, a low cone, and is constituted of radial spicular strands which are an immediate continuation of the vertical fascicles of the reticulum, those being crossed by concentric strands, corresponding to the horizontal bundles of the rest of the skeleton. The radial strands converge at or near the center of the cone, and when the outer part of the cone is preserved there is evidence of the existence of a spicular tuft about the apex. Not all the rods of the vertical bundles extend from the body of the sponge into this plate; a portion of them is continued into the broad thin peripheral frill, the surface of which is crenulated, while its distal margin is irregularly fringed by long radiciform extensions. The radial spicules of

*OWEN at first regarded this sieve-plate as at the bottom of EUPLECTELLA (See SCHULZE, *op.cit.* p. 54).
†Challenger Expedition, vol. xxi; Hexactinellida, p. 66.

the terminal plate in these genera, and their continuity with the rest of the skeleton, of itself demonstrates the fact that this is the base of the sponge, and is not in the remotest sense homologous with the sieve-plate in EUPLECTELLA; this evidence is corroborated by the structure of the peripheral frill and its evident adaptation to the purposes of attachment as seen in the character of its distal margin.

From this consideration of the characters of the Dictyosponges and the groups allied to them, may be deduced the following definition of the family:

Family **DICTYOSPONGIDÆ**, Hall.

Obconical, prismatic, cylindric, explanate, vase, funnel and saucer-shaped, thin-walled sponges, with the inner layer of the skeleton composed of series of reticulating vertical and horizontal bundles mostly of smooth diactine rods; the outer layer composed of regularly arranged stauractins forming quadrate meshes with more or less irregularly disposed spicules scattered over the quadrules thus produced (pinulus, clavules, etc.). Regular hexactins in the parenchyma. Single lophophyte generally present. Periloph, marginalia and pleuralia present or absent. No mural areoles; no terminal sieve-plate.

STRUCTURE OF THE SKELETON.

In contrast to the very considerable generic variation and abundant specific representation now recognized in this family, our knowledge of the spicular elements of the skeleton is, and must remain, very incomplete. This is the more to be regretted, since the structure of this frame-work is the essential basis of taxonomic arrangement. Among the abundant species of the Devonian, this skeleton, almost without exception, is lost, however clear and undisturbed the original form of the sponge and the impression of its surface characters. In the sands and sandy shales of the Chemung group from which the great majority of these sponges has been obtained, the original hydrated silica of the skeleton has undergone change, probably through the agency of organic acids resulting from decomposition, and has been replaced first by pyrite, and by oxidation this has passed into limonite and been quickly removed from the porous rock. In rare instances portions of the spicular rods in the condition of limonite have been seen in specimens from the upper Devonian and more often in those from the sandy layers of the lower Carboniferous (Waverly group) of Ohio. The calcareous shales in which the sponges of the Keokuk group at Crawfordsville and Indian Creek, Indiana, are embedded, have, however, retained a greater or less portion of the

skeletons in a pyritized condition, and it is from this source that all our knowledge of their ultimate composition is derived. As already observed, the frame work of these sponges consists of bundles of rods crossing at right angles. The majority of these are smooth and taper very gradually, not necessarily extending for the entire length of the sponge. Close observation has not yet shown them to have more than a single axis, that is, they are not

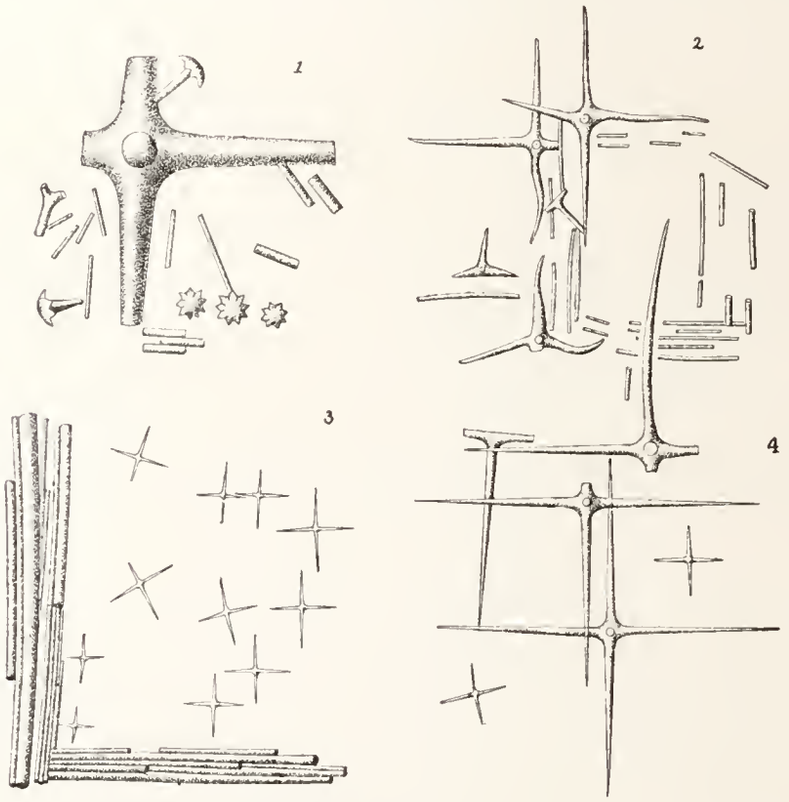


FIGURE 4. Spicules of Dictyospongidæ.

1. Part of a primary pentactin of *Cleodictya Mohri*, with umbels in various positions, and fragments of other spicular rods x 60.
2. Two angles of a quadrule in *Phragmodictya catilliformis*, the primary hexactins or pentactins being in place, with fragments of the vertical and horizontal bundles. x 50
3. Part of a quadrule, showing the vertical and horizontal bundles with parenchymal spicules scattered over the interspace. x 40. From an undetermined fragment at Crawfordsville, Indiana.
4. Some of the major and minor hexactins of *Dictyospongia ? Marcellia*. x 30.

crossed by other rays. Such rods may, therefore, be regarded as extreme modifications of the typical triaxial or hexactinellid form, produced by the abbreviation of two of the axes. The terminal portion of a very small rod (*Mastodictya osculata*) enlarged 400 diameters, is represented in the accompanying figure 5. In some genera, particularly in PHYSOSPONGIA, vertical bundles of these rods, which lie on the inner or paragastral surface of the sponge, are accompanied by comparatively short rods which terminate in an anchor with two sharp flukes (figure 5). These had nothing to do with the fixation of

the sponge as, in *Physospongia Dawsoni*, they are scattered over the entire length of the principal vertical paragastral strands. The relation of their form to the normal hexactins may be understood by observing that the sides of the head of the anchor not extended into spines are much swollen, forming abbreviated representatives of the rays of the third axis. With these anchorate rods are others, occurring in PHYSOSPONGIA, CLATHROSPONGIA and LYRODICTYA, which may be termed *clemes;* formed of flattened rods with alternating broad triangular processes at the sides (figure 5). The anchorate and clemate rods are found together, but only in the vertical fascicles. The spicules of the outer or dermal wall of the reticulum are seldom retained in place, and the precise position of some of the forms is to a considerable degree a matter of conjecture. Here there are no smooth rods, anchorate spicules or clemes, or if the first are ever present, they are small and of rare occurrence. The mesh of the outer wall is, as already observed, composed of stauractins, principally pentactins, which lie at the angles of small quadrate areas (see figure 4). These pentactins are usually smooth-rayed but not infrequently they bear thorns or long spinules (figure 6 (9)). In these pentactins a single low node near the intersection of the axes is frequently present and represents a sixth ray. The surface of the quadrules set off by the principal pentactins is covered with, or filled by, isolated spicules of various forms. It is not easy to conclude, except from comparison with living hexactinellids, which of these spicules are referable to the dermal layer and what portion of them to the interstitial or parenchymal layer of the reticulum. On account of the thinness of the entire sponge wall, the distinction of such an intermediate layer is perhaps a purely conventional one. It is usually extremely difficult to discriminate between the outer and inner layers of the skeleton especially when under compression, but the

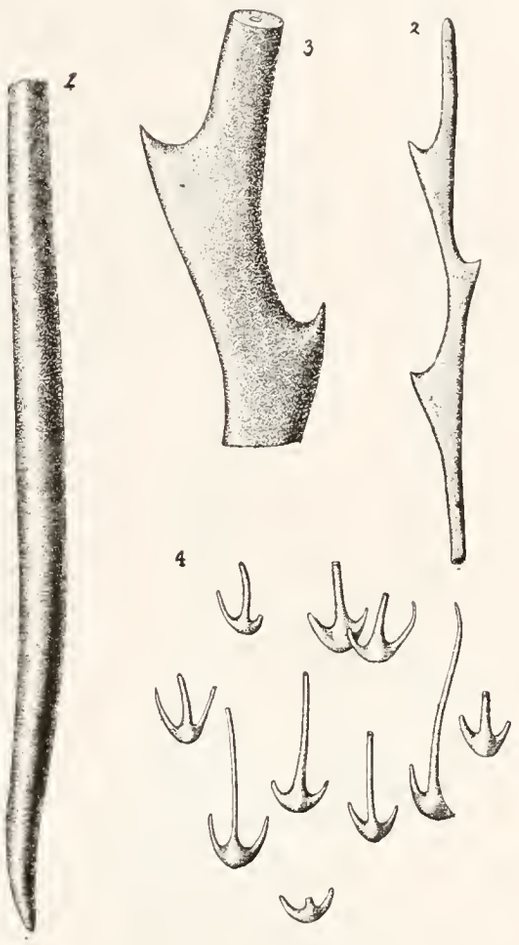


FIGURE 5. Spicules of Dictyospongidæ.

1. Terminal portion of a small vertical rod in *Mastodictya osculata*. x 400.
2. Cleme of *Physospongia Dawsoni*. x 60.
3. Part of cleme of *Aclœodictya marsipus*. x 400.
4. Group of anchorate spicules, *Physospongia Dawsoni*. x 60.

presence of certain spicules similar to those which, in recent siliceous sponges, are found in the sarcode of the inner layer, is a reason for ascribing such layers to the DICTYOSPONGIDÆ.

To the dermal layer may be ascribed the umbrella-shaped clavules, or umbels, occuring in CLEODICTYA, PHYSOSPONGIA and GRIPHODICTYA (figures 6, 7); short, thick rods with an arched, toothed disk at the end. To the same layers, also, various forms of the pinules, some clearly pentactin, others compound, among them the peculiar *tri-pinulus* which consists of three tufted rays rising from a smooth base with accessory processes (figure 6). These pinules have seldom been found unbroken with the exception of the tri-pinulus, a form occurring in CLEODICTYA and LEBEDICTYA. To the parenchyma (or perhaps to the quadrules of the inner wall) may belong certain peculiar pentactins with curved rays, found only in *Phragmodictya catilliformis* (figure 6 (1-4)) and the pod-shaped diactins which occur in PHRAGMODICTYA, LEBEDICTYA, PHYSOSPONGIA, GRIPHODICTYA, etc., and perhaps also, the highly branched oxyhexasters characteristic of the genus GRIPHODICTYA (figure 7).

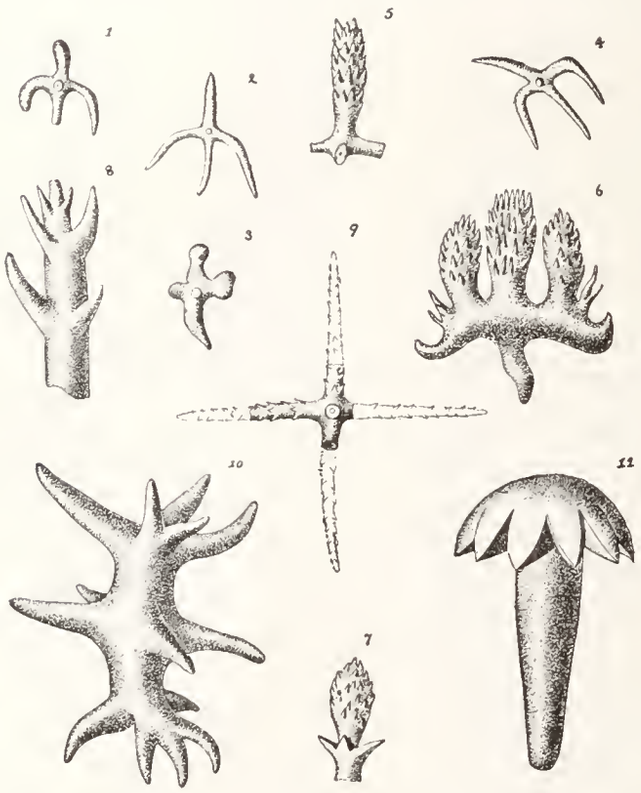


FIGURE 6. Spicules of Dictyospongidæ.

1, 2, 3, 4. Modified hexactins of *Phragmodictya catilliformis*. x 400.
5, 6, 7. Different forms of the pinulus from *Cleodictya Mohri*. x 400; 6 is a complete tri-pinulus.
8, 9. Parts of echinate hexactins, also from *Cleo. Mohri*. x 400.
10. A much modified spicule from *Griphodictya epiphanes*. x 400.
11. An umbel; *Physospongia Colletti*. x 400.

The prostalia or tufts of spicular rods occurring at the base, aperture and at various nodes upon the surface of some species, seem to penetrate the entire wall and, in some instances, as in HYDNOCERAS and PHYSOSPONGIA, to bear a definite relation to the intersections of the vertical and horizontal faeicles of the inner wall.

NOTE. The terminology of the spicular elements of the sponges has in recent years become very complicated through an exuberant growth of terms which do not explain themselves. The present profusion of names is quite bewildering while the fundamental conception of the spicule form is perfectly simple and the mode of its modification not of itself necessarily

complex. To serve the purposes of this work we have brought together in figure 8 a group of the more characteristic derivative forms of the hexactin spicule, which has been compiled from the illustrations given by Schulze (*Report Challenger Expedition*) and Rauff (*Palaeospongiologie*). These will aid in elucidating the spicular forms occurring in the Dictyspongidæ.

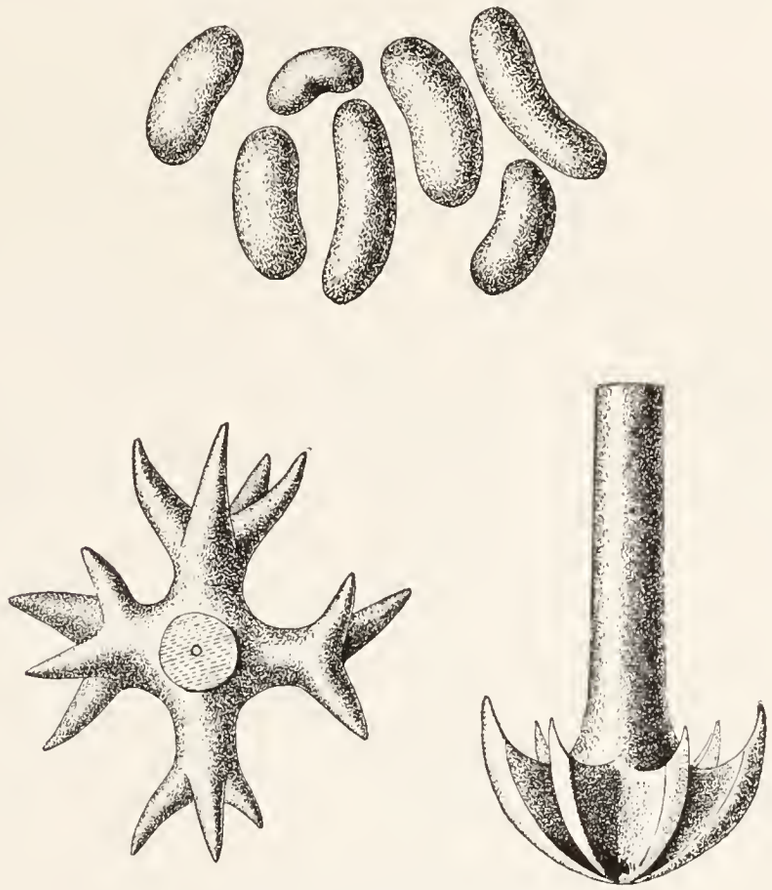


Figure 7. Spicules of Dictyospongidæ.

The upper figure is a group of stout bean-shaped diactins from an undetermined fragment at Crawfordsville, Indiana. The two lower spicules are from *Griphodictya epiphanes;* that at the left is an hexactin much branched at the extremity of the rays; that at the right an umbel with deeply cleft top. All x 400.

Variations and Genetic Relations of Form.

A glance through the plates of this volume will convey an idea of the multiplicity of forms under which the Dictyosponges manifested themselves. Among these smooth, nodose, prismatic and annulated cups and vases, the smooth slender obcone as expressed in the typical genus Dictyospongia, is doubtless to be regarded as the fundamental form. The primary relation of this form to all the abundant expressions occurring in the Devonian faunas is evident from an inspection of any well-preserved example of a nodose, prismatic, annulated or other form, in all of which the early stages are

regularly obconical. In HYDNOCERAS this primitive, smooth condition was of brief duration and was directly followed by the development of prism-faces, at first four and directly thereafter eight, the normal number. These prism-faces are well developed before the appearance of the nodes on the prism-

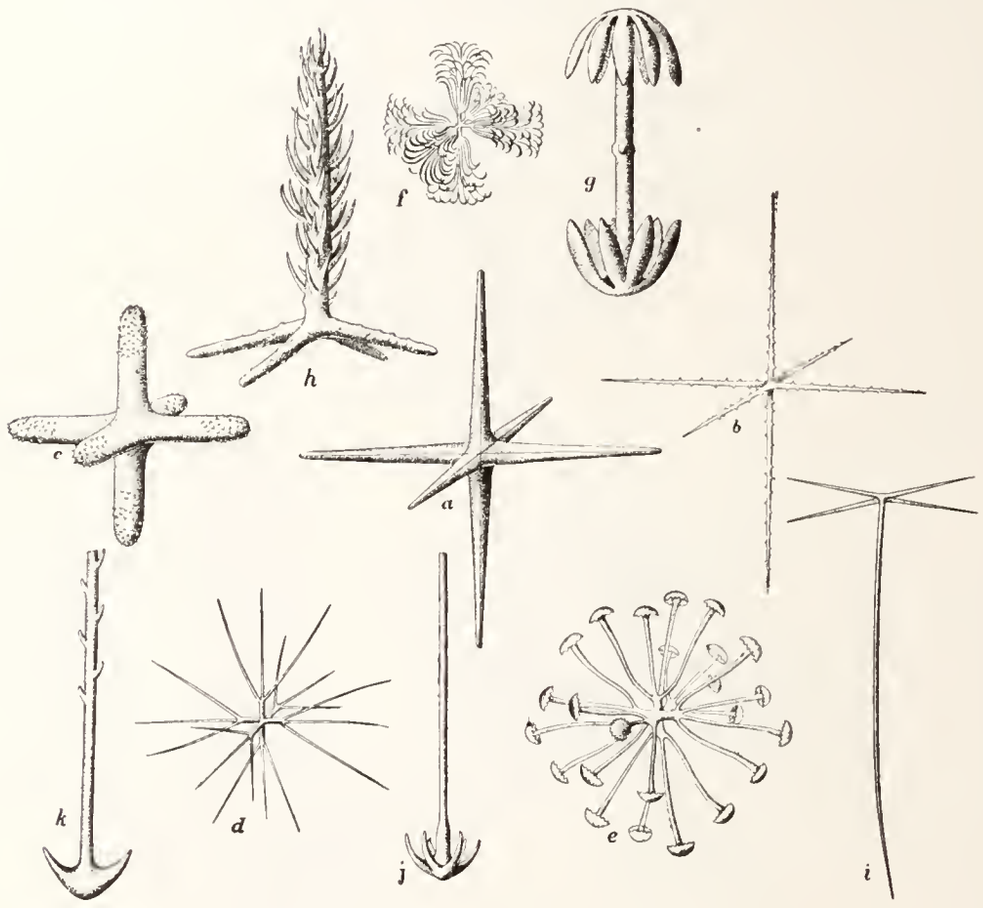


FIGURE 8. Primary and modified forms of the Hexactin.

a. Oxyhexactin, x 100; *b*. Echinhexactin, x 300; *c*. Strongylhexactin with prickly extremities, x 450; *d*. Tylhexaster, x 300; *e*. Discohexaster, x 450; *f*. Plumicome, x 300; *g*. Amphidisk, with remnants of the abbreviated arms, x 100; *h*. Pinule, x 300; *i*. Orthotetraen, x 100; *j*. Clavule, x 450; *k*. Diaen, x 150. (RAUFF.)

angles. The nodes themselves do not appear abruptly but with gradual increase in size, and after the passage of the adult period their size again decreases, and eventually they disappear; the prismatic faces also become obsolete, the apertural portions of old individuals being smooth and funnel-shaped.

The remarkable genus BOTRYODICTYA retains the smooth, primitive, subcylindrical form of the cup for fully one-half its length and then abruptly swells into a vase with obscure prism-faces and an extravagant development of compound pouch-shaped nodes. In the great majority of all of the Devonian species of these sponges the prism-faces are more or less clearly discernible,

even among forms belonging to the genus DICTYOSPONGIA, so that this prismatic form seems in a certain sense normal to the group, though always a progressed condition. In some of the annulated species, as RHABDOSPONGIA, the annulations are clearly of subsequent appearance to the prism-faces, though the latter are represented throughout the adult condition of the sponge as vertical ridges; while in CERATODICTYA the annulations appear to follow directly upon the smooth conical condition, the prismatic condition not being manifested.

It is a significant fact that even with our present imperfect knowledge of this group, the earliest known Dictyosponge, *Dictyospongia Danbyi*, McCoy (sp.), from the Ludlow beds of England, is such a regularly obconical species with, possibly, an obscure development of the prism-faces toward its upper part. This simple form may be regarded as directly derived from that which characterizes such earlier Silurian forms as CYATHODICTYA. The secondary modifications of this form (prism-faces, nodes, annulations, etc.), are not known in any such early species nor outside of the DICTYOSPONGIDÆ.

Among the many prismatic or banana-shaped species which constitute the genus PRISMODICTYA, the early smooth conical stage is extremely abbreviated, but when specimens are well preserved to the basal apex it is found that such a condition exists.

With the disappearance of the Devonian faunas, the simple prismatic sponges quickly disappear. The introduction of the Waverly fauna, immediately succeeding the upper Devonian in Pennsylvania and Ohio, brought in several new generic types, some of which retain the prismatic form under considerable modification (CALATHOSPONGIA), but in the preponderating species the prismatic structure is essentially lost. THAMNODICTYA and CLEODICTYA are sponges with a smooth surface; the simple, obconical form of the cup is modified in both, in the former the base of the cup being broad and its apertural portion expanded into a wide vase, and in the latter, the bowl-like lower part of the sponge bearing a row of nodes which seem to have no relation to prismatic faces as in all of the nodose species of the Devonian.

The still later fauna of the Keokuk group as represented in eastern Indiana, brings in the remarkable genus PHYSOSPONGIA, a broadly conical sponge with wide base, and having the inner wall of its skeleton constructed on a very simple plan; a modification of the normal type of structure which is evidently foreshadowed in the *Roemerispongia Geroldsteinensis*, F. Roemer, of the middle Devonian of Germany. In this fauna is, also, the genus PHRAGMODICTYA, a non-prismatic sponge characterized by its depressed conical base surrounded by a

peripheral frill; a form anticipated in the THYSANODICTYA of the upper Devonian, in which evidence of the prism-faces is still retained. In the greater number of all the other known species represented by the genera CLEODICTYA, LEBEDICTYA, CALATHOSPONGIA and LYRODICTYA, the form is some modification of a rapidly expanding obcone or vase, like the ultimate expanded apertural portions of the Devonian nodose sponges. With all these generic modifications so unlike those prevailing in the Devonian, are still to be found a few representatives of the genera PRISMODICTYA and DICTYOSPONGIA.

Though the future will doubtless afford much evidence helping to establish the mutual relations of form among the Dictyosponges, the evidence of the present clearly points to the simple, slender, smooth obcone as primitive, probably derived from the antecedent PLECTODERMATIDÆ and PROTOSPONGIDÆ, and attaining its maximum in the upper Devonian; to the prismatic form as a primary derivation therefrom, a group also attaining its highest development in the upper Devonian; to the nodose and annulated forms as a secondary derivation, and the explanate, non-prismatic vase-shaped species with their various modifications, such as prevail in the lower Carboniferous faunas, as a still later derivation from the fundamental type.

MODES OF PRESERVATION.

The skeletal substance of the siliceous sponges is a hydrated or chalcedonic silica. In these fossils, as preserved in the older rocks, this skeleton has been wholly removed and replaced by some other substance.* In a single instance among all the examples here described, *Clathrospongia Hamiltonensis*, from the calcareous shales of the Hamilton group, the skeleton has been substituted by a deposit of carbonate of lime, which retains the general aspect of the net-work though the form and structure of the individual spicular bodies is wholly lost. In all other cases that have come under our observation the replacement of the siliceous skeleton has been a complicated one resulting in the substitution of iron pyrites for the silica, and with such delicacy and so gradually has this process been carried forward, that the minutest details of form in spicules of highly intricate structure have been retained.

Notwithstanding the fact that, almost without exception, in all the numerous sponges of the upper Devonian sandstones, the spicular skeleton is entirely gone, it is evident that its absence is not due to a lack of replacement by pyrites but to a removal of the pyrites itself. This appears from the

* ZITTEL observes that in the older lithistid siliceous sponges the original amorphous, singly refraetive silica has become doubly refraetive, and almost insoluble in caustic alkalies (*Annals and Magazine of Natural History*, vol. 20, 1877, pp. 260 *et seq.*).

occasional presence in examples from these and the similar sandstones of the Waverly group, of a few root spicules which are in the condition of hydrated oxide of iron (limonite), as well as from the iron stains which frequently accompany much of the material from all such rocks. The porous sandy matrix of both horizons has been an efficient aid to the removal of the skeleton. Where replacement has gone on in the presence of abundant decomposing organic matter, as in the bituminous rocks of the Quebec group, Utica slates and Marcellus shales, the deposition of pyrite is complete and sometimes excessive; so that the form of the spicules may become obscured by pyritous enlargement.

In the calcareous shales of the Keokuk group in Indiana, the pyritous replacement is often retained. The fact that it is not always present but that in the majority of instances it has been lost, leads to the inference that the removal of the pyritized skeleton is constantly in process. It is, however, to the sponges of this horizon that is due such knowledge as we now possess of the ultimate spicular structure in the DICTYOSPONGIDÆ.

Although the sandstones of the Devonian and lower Carboniferous have proven unsatisfactory media for the retention of the skeleton they have well preserved the form of the sponges. They have been, at times, subjected to slight distortion from compression, but this disfiguration is always much less in these rocks than in those more highly laminated and of finer texture. The impressions of the interior and exterior of the skeleton are often so sharply defined as to afford a very clear conception of the structure of the network and the ornamentation of the surface, the slight discoloration of superficial ridges and laminae by iron stains frequently aiding such conceptions. While specific and generic characters in this family are so largely dependent upon variations of form, this mode of preservation is by no means unsatisfactory, as the shape of the sponge is usually better preserved than in more schistose sediments.

HABITAT AND MODE OF OCCURRENCE.

The prevalence of these Dictyosponges in the sandy sediments of the Chemung group is in strong contrast to the distribution of existing hexactinellids over the present sea-bottom. The Chemung formation of the central-western part of the State of New York is essentially a succession of arenaceous beds in the condition of compact sandstones and sandy shales, with occasional layers of argillaceous shale and, toward the upper part of the series, with gravelly conglomerates. In all of these sponge remains have been found, but the occurrence of isolated specimens alone can not be relied upon to determine

the nature of their habitat; for in many instances there is collateral evidence of the sponge having been drifted from its proper position.

The known colonies of these sponges afford more direct evidence. The colony of *Hydnoceras Bathense*, at Bath, lies overwhelmed between banks of sandstone and involved in a few inches of a somewhat arenaceous clay-shale. Its existence was terminated abruptly, as shown by the fact that the great majority of the individuals are confined to a very thin layer at the surface of the sandstone and by the additional fact that all have been greatly compressed. Now it is found that while the exposed surface of these overwhelmed sponges may be covered with the shaly rock, their under surfaces are involved in the sand and, further, occasional specimens are found quite buried in the sandstone stratum itself. It is possible that this extensive sponge plantation grew upon the muddy bottom represented by the thin layer of shale, though the data more clearly indicate that it was rooted on the sandy bottom and was overwhelmed by the influx of mud. A great number of specimens of *Hydnoceras botrædema* have been taken from the soil on Irish hill, near Bath, and though the rock beds from which they come have not yet been opened, the specimens are uncompressed internal casts in sandstone, both their form and matrix indicating the absence of a muddy sediment. The colony of *Hydnoceras tuberosum* at Brown hill, near Cohocton, that on Hamlin's farm, near Naples, and the one at Cotton hill, near Avoca, in the last of which is a number of diverse species, are all in a soft sandy sediment, which is highly laminated and schistose but is not shaly nor does it show other evidence of muddy bottom except so far as the mud is commingled with the sand. At Cuba, Allegany county, is a small colony of *Dictyospongia sceptrum* which occurs in a heavy sandstone stratum and the sponges have been prostrated not by any change in the nature of the deposit, but rather by the impact of the waves or water currents. This is indicated in the accompanying cut which shows three overthrown individuals lying side by side and parallel, having evidently fallen where they grew.

In other cases there is evidence of considerable admixture of muddy matter in the sediment, as in the colony of *Thysanodictya Edwin-Halli* at Wellsville, where the rock is soft and the specimens in large part compressed; but even here the matrix is still arenaceous and many specimens are without compression. In this plantation from which several hundred specimens have been taken, the sponges are found at times to retain their upright position, thus indicating how gently the sediments have been deposited about them. Fifty miles away from Wellsville, which may be regarded as the geographic center of the most prolific sponge region in the upper Chemung beds, occurs

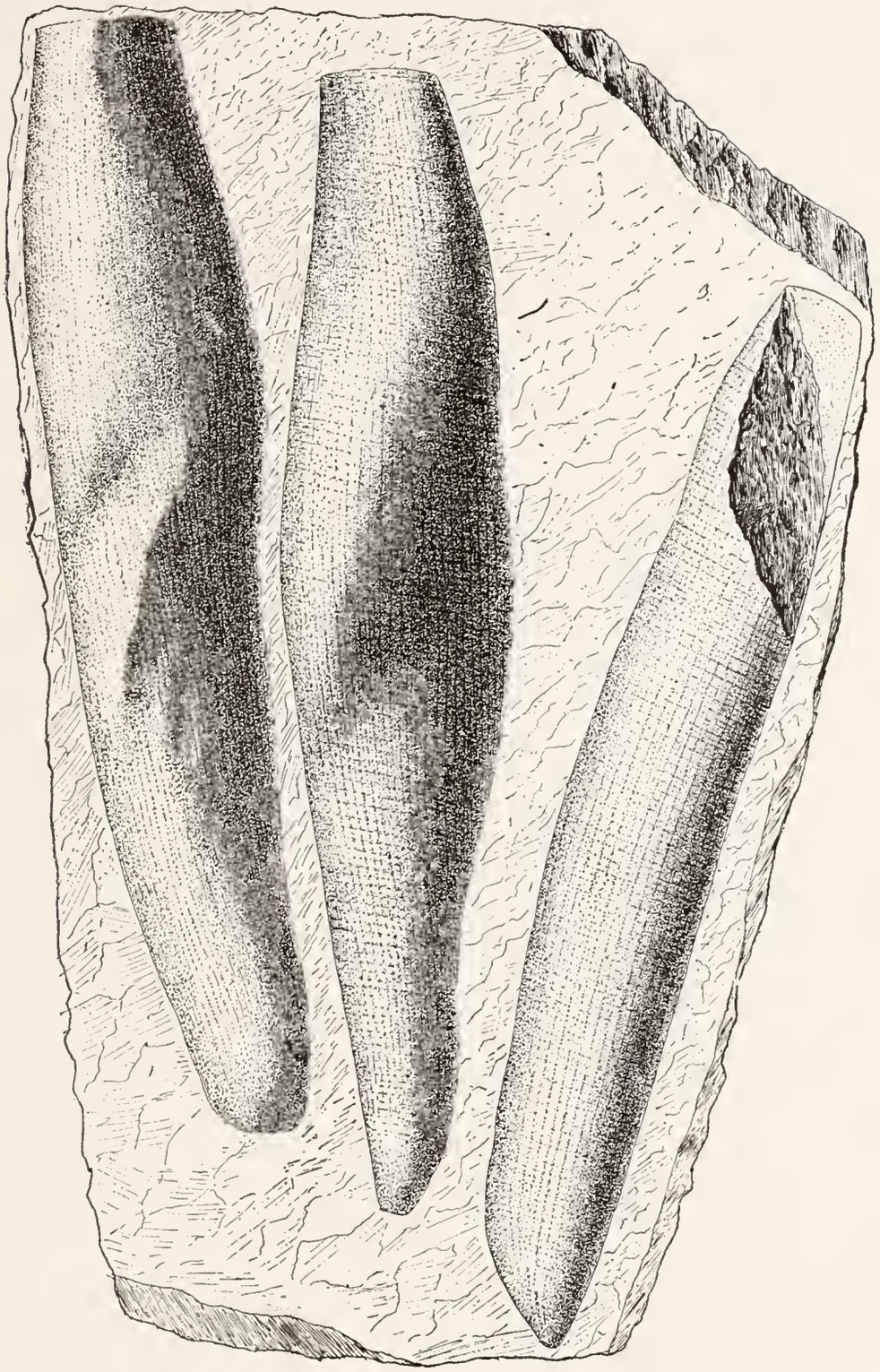


FIGURE 9. Three prostrate individuals of *Dictyospongia sceptrum*, which were rooted in a sandy sediment. Chemung sandstone, Cuba, N. Y.

Botryodictya ramosa in a soft sandy shale, near Mansfield, Tioga county, Pennsylvania, the only locality at which it has been observed.

Many of the sandstones of the Chemung series are rich in molluscan and other fossils, constituting a profuse and diverse assemblage of organic life, but the diffusion of this fauna is not uniform throughout the series. The fossils predominate in rather thin layers separated by intervals of barren sands. The sponges, however, do not usually occur in these highly fossiliferous bands. In the colonies at Bath and near Cohocton, the species of HYDNOCERAS have almost no other organic associates and their prolific growth seems to have crowded out other forms of life. Occasionally the cup of a *Taxocrinus* has been found among the sponges at the latter locality but no other organisms have been observed in the colonies at Bath. On the other hand, very near the base of the Chemung group, on Hamlin's farm in the township of Naples, and not over 150 feet above the last Portage fauna, is a colony of HYDNOCERAS where the specimens, not well preserved on account of the laminated condition of the sediments, are associated with these species: *Ambocælia umbonata*, var. *gregaria*, *Cyrtina Hamiltonensis*, *Stropheodonta Cayuta*, *S. variabilis*, *S. arcuata*, *Leptostrophia perplana* var. *nervosa*, *Aviculopecten cancellatus*, *Sphenotus* sp., *Arthracantha* sp. Three miles away, at Deyo basin, in the same town, HYDNOCERAS occurs sparingly, with CERATODICTYA, HYDRIODICTYA, *Spirifer mesastrialis*, *Atrypa hystrix* and *Productella speciosa*.

In the upper part of the formation throughout the region in Allegany county which has proved so prolific in Dictyosponges, these species are frequently associated with *Spirifer disjunctus*, *Productella*, *Camarotœchia* and other brachiopods.

Such a habitat for these sponges as is indicated by the foregoing evidence is dissimilar to that of the recent hexactinellids. F. E. SCHULZE reports the number of species dredged by the Challenger Expedition, from the bottom of mud, clay or globigerina-ooze, as nearly twice that found on all other kinds of bottom. Of about one hundred species, five were trawled from sand and but two from gravel and stones. The EUPLECTELLIDÆ and other forms provided with a root tuft were mostly found on soft muddy ground. *Euplectella aspergillum* was taken in mud at a depth of 95 fathoms, while *E. crassistellata* was dredged in radiolarian-ooze at the immense depth of 2750 fathoms, the two species representing the extreme of depth at which the Hexactinellida were found.

These ancient allies and precursors of EUPLECTELLA seem to have been adapted to different conditions of growth. They flourished and attained their

highest development upon the sands and arenaceous muds of the upper Devonian, and among them are those most frequently provided with a root-tuft. The species of the Keokuk group grew on a soft muddy bottom like many of their modern representatives, accompanied by a profuse growth of crinoids and with many mollusca and brachiopoda; and while some of the species of the latter fauna are provided with root-tufts, the majority have broad bases indicating a sessile mode of growth on solid objects such as stones or dead shells.

HISTORICAL.

BIBLIOGRAPHY OF THE DICTYOSPONGIDÆ

1842.

1. T. A. CONRAD. *Observations on the Silurian and Devonian Systems of the United States, with descriptions of New Organic Remains.* (Proc. Acad. Nat. Sci. Philadelphia, vol. 8, pp. 267–8, pl. xvi, fig. 1.)

Describes the genus HYDNOCERAS and the species *H. tuberosum*, stated to be from the Chemung sandstones near Addison, Steuben county, N. Y. The author's account of this sponge was based on an internal cast which he conceived to represent an extravagant form of cephalopoda.

2. L. VANUXEM. *Geology of New York; Report on the Third District, pp. 182–3, fig. 50.*

A brief description is given, with a figure of an incomplete specimen of *Uphantænia* (*Hyphantænia*) *Chemungensis*, obtained from the Chemung sandstones "near the south end of the Ithaca and Oswego railroad." The author expresses his belief that the fossil was a marine plant. A figure of the original specimen will be found among the plates of this volume.

1852.

3. FREDERICK MCCOY. *A systematic Description of the British Palæozoic Fossils in the Geological Museum of the University of Cambridge, p. 62, pl. 1. D, figs. 7, 8.*

Under the name *Tetragonis Danbyi*, the author describes a species of DICTYOSPONGIA from the upper Ludlow rocks of Westmoreland, evidently regarding the fossil a cystidean. It is placed among the *Echinodermata* in MORRIS's *Catalogue of British Fossils*, p. 90, 1854, MURCHISON's *Siluria*, third edition p. 536, 1859, and fourth edition, p. 509, 1872. In SALTER's *Catalogue of the Cambrian and Silurian Fossils contained in the*

Geological Museum of the University of Cambridge, p. 176, 1873, the species is placed among the Sponges.

1862.

4. J. W. DAWSON. *On the Flora of the Devonian Period in Northeastern America.* (Quarterly Journal Geological Society, vol. xviii, p. 325, pl. xvii.)

Under the name *Uphantænia Chemungensis*, the author figures a specimen of *Hydnoceras tuberosum* from the Chemung group of New York and suggests that such forms were the cylindrical stems of the flabellate fronds described by VANUXEM under the former term. They are regarded "as *Algæ* with funnel-shaped fronds, sometimes prolonged into cylinders, and when adult, bearing fructification in tubercles on the sides of the cylinders."

1863.

5. JAMES HALL. *Observations upon the Genera Uphantænia and Dictyophyton, with notices of some Species from the Chemung group of New York and the Waverly sandstone of Ohio.* (Sixteenth Ann. Rep. N. Y. State Cab. Nat. Hist. pp. 84–91, pls. iii–v a.)

A description is given of *Uphantænia Chemungensis* with reprint from the original cut, but without additional specimens. The genus DICTYOPHYTON is introduced, based upon the species *D. Newberryi*, and, at the request of Mr. CONRAD (as stated in a foot-note to page 87), it is allowed to replace the term HYDNOCERAS. The following species of DICTYOPHYTON are described:

D. Newberryi, nov.
D. filitextile, nov.
D. Redfieldi, nov.
D. Conradi, nov.
D. rude, nov.
D. fenestratum, nov.
D. annulatum, nov.
D. tuberosum, Conrad.
D. nodosum, nov.

All of these fossils are regarded as marine Algae.

1874.

6. E. P. LARKIN. *Dictyophyton.* (The Alfred Student, May, p. 53; A paper published under the auspices of Alfred University, at Alfred, Allegany county, N. Y.)

Describes a number of supposed variations of *D. tuberosum* and new species, viz.: *D. serratum*, *D. angulatum*, *D. lobatum*, *D. cylindricum*, *D. hastatum*. The descriptions are very incomplete and, in the absence of illustrations, the forms intended can not be recognized.

1879.

7. W. PH. SCHIMPER. *Zittel's Handbuch der Palaeontologie; Part II. Palaeophytolologie, Lief. 1, p. 69.*

The genera DICTYOPHYTON and UPHANTÆNIA are considered under a group of algae termed DICTYOPHYTEÆ. In regard to the genus DICTYOPHYTON, however, the author observed: "This regular lattice-work is so sharply defined and the elevated lines so uniformly straight that such impressions could be left in the rock only by bodies composed of very firm parts. Among living algae there are none which have such a composition. There are indeed very delicate algae which become hardened by calcareous incrustation, but such an ornamentation as this can not be the result of incrustation.

"The question arises whether we have not here the siliceous skeletons of sponges rather than highly abnormal forms of algae. We know how regularly the skeletons of the sponges are often constructed, and that a quadrate network is not infrequent among them. It is to be farther remarked that, as stated by HALL, no trace of coal on these remains has been observed."

Similar doubt is expressed as to the algous nature of UPHANTÆNIA.

1880.

8. FERDINAND ROEMER. *Lethæa Palæozoica, Erste Lieferung, pp. 127, 128, fig. 3, and p. 304, fig. 56.*

Describes the genera UPHANTÆNIA and DICTYOPHYTON, giving a figure of *Dictyophyton tuberosum* from Steuben county. Both are discussed among the fossil algae but are regarded as doubtfully of this nature. On pp. 303, 304, the genus TETRAGONIS and the species *T. Murchisonii*, Eichwald, *T. Danbyi*, McCoy and *T. Eifeliensis*, n. sp. are discussed, the last being illustrated by a fragment of the surface from the calcareous middle Devonian shales of Gerolstein. The genus is included in the family *Receptaculitidæ*.

1881.

9. R. P. WHITFIELD. *Observations on the Structure of Dictyophyton and its affinities with certain sponges.* (Amer. Journ. Science, vol. xxii, pp. 53, 54.)

Upon comparison of specimens of DICTYOPHYTON which had been described from the sandstones of the Chemung and Waverly groups, with the skeleton of EUPLECTELLA, the author concludes that these bodies are sponges, at

the same time setting forth the *a priori* evidence against their supposed vegetable nature.

10. R. P. WHITFIELD. *On the Nature of Dictyophyton.* (Amer. Journ. Science, vol. xxii, p. 132.)

Briefly refers to additional evidence of the spongous nature of these fossils, based upon a specimen from the Keokuk beds at Crawfordsville, Indiana, for which the name of *Uphantænia Dawsoni* is introduced. The specimen was referred to Dr. J. W. DAWSON for examination.

11. J. W. DAWSON. *Note on the Structure of a specimen of Uphantænia, from the Collection of the American Museum of Natural History, New York City.* (Amer. Journ. Science, vol. xxii, pp. 132, 133.)

This examination of a pyritized specimen from Crawfordsville, leads the author to conclude that it is probably a sponge

1882.

12. WARD'S *Natural Science Bulletin, vol 1, No. 1, p. 5.*

Gives a notice of the finding of the colony of *Dictyophyton* (*Hydnoceras*) *tuberosum*, Conrad, in the town of Cohocton, Steuben county, N. Y.

13 JAMES HALL. *Notes on the Family Dictyospongi[d]æ, plates 17–20, with explanations.* (Issued in advance of the Thirty-fifth Annual Report N. Y. State Museum of Natural History, 1884.)

The explanations accompanying these plates differ in some respects from those in the final form of the paper in the matter of generic identifications. The following species take date from this publication: *Dictyophyton* [*Ectenodictya*] *implexum*, *Clathrospongia abacus*, *Dictyophyton* [*Tylodictya*] *tenue*, *Phragmodictya* [*Aclæodictya*] *excentrica*, *P. scyphus* (=*P. catilliformis*, Whitfield), *Physospongia alternata*, *Phragmodictya* [*Thysanodictya*] *expansa*, *P. crebristriata*, *P. lineata.*

14. R. P. WHITFIELD. *Remarks on Dictyophyton and Descriptions of New Species of allied forms from the Keokuk beds of Crawfordsville, Indiana.* (Bull. No. I, Amer. Mus. Nat. Hist. pp. 10–20, pls. iii, iv.)

Reproduces the substance of observations made by the author and Princ. DAWSON (Nos. 9, 10, 11), redescribes *Uphantænia* [*Physospongia*] *Dawsoni* and gives the first descriptions of *Dictyophyton* [*Phragmodictya*] *catilliforme* and *D.* [*Dictyospongia*] *cylindricum*, all from the Keokuk group of Indiana.

15. K. A. VON ZITTEL. *Notizen über fossile Spongien (Protospongia, Dictyophyton, Corynella, Stellispongia, Verticillites).* (Neues Jahrb. für Mineral. vol. 2, pp. 203, 204.)

From the examination of a "Dictyophyton" [*tuberosum*, Conrad] sent to him by Professor WARD, of Rochester, the author confirms the opinion of WHITFIELD and HINDE, that the fossil belongs to the sponges and regards it as forming, with PROTOSPONGIA, a distinct family allied to EUPLECTELLA.

1883.

16. JAMES HALL. *On the Relations of Dictyophyton, Phragmodictyum and similar Forms with Uphantænia.* (Proc. Amer. Assoc. Adv. Sci., vol. 31 (for 1882), p. 419. Title only.)

17. CHARLES BARROIS. *Sur les Dictyospongidæ des Psammites du Condroz.* (Annales de la Soc. Geol. du Nord, vol. xi, pp. 80–86, pl. 1.)

The author records the occurrence of these sponges in the upper Devonian sandstones of Jeumont, Brittany, and identifies certain of them with the *Dictyophyton tuberosum*, Conrad [*Hydnoceras Barroisi*]. Another species is described as *D.* [*Dictyospongia*] *Morini*. It is suggested that these sponges belong to the suborder *Dictyonina*, Zittel.

18. GEORGE J. HINDE. *Catalogue of the Fossil Sponges in the Geological Department of the British Museum, pp. 130–132, pl. xviii, fig. 3.*

The author places the genus DICTYOPHYTON among the Dictyonine sponges, under the family STAURODERMIDÆ, and in immediate association with PROTOSPONGIA, Salter. The view is expressed that the nine species of DICTYOPHYTON described by HALL (1863), probably all belong to the species *D. tuberosum*, Conrad, and that the *Tetragonis* [*Prismodictya*] *Eifeliensis*, F. Roemer, represents the same genus. A figure is given of a specimen from Cohocton, N. Y., probably the normal form of the species from the Brown hill colony. McCOY's species, *Tetragonis Danbyi*, is also described as *Dictyophyton Danbyi*, and it is observed that an examination of the original species of TETRAGONIS (*T. Murchisoni*, Eichwald) shows it to be closely allied to ISCHADITES.

19. FERDINAND ROEMER. *Notiz über die Gattung Dictyophyton.* (Zeitschr. der Deutsch. Geolog. Gesellsch., vol. xxxv, pp. 704–708, figs. a, b.)

Describes and figures a Dictyosponge from the middle Devonian of Gerolstein, under the name *Dictyophyton Gerolsteinense*. It is shown in the

following pages that this species represents a distinct type of generic structure and the name ROEMERISPONGIA is here introduced therefor. The author considers neither the algous nor the spongous nature of these fossils established.

1884.

20 JAMES HALL. *Descriptions of the Species of Fossil Reticulate Sponges, constituting the Family Dictyospongidæ.* (Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist. pp. 465–481, pls. 17 (18)–20 (21).)

This paper defines the new genera ECTENODICTYA, LYRODICTYA, THAMNODICTYA, PHRAGMODICTYA (1882), CLEODICTYA and PHYSOSPONGIA (1882), and gives brief descriptions of all the species known at that time. The following species take date from this publication: *Dictyophyton* [*Clathrospongia*] *Hamiltonense*, *D.* [*Hydriodictya*] *patulum*, *D.* [*Prismodictya*] *prismaticum*, *D.* [*P.*] *telum*, *D.* [*P.*] *baculum*, *D.* [*P.*] *parallelum*, *D.* [*Clathrospongia*] *irregulare*, *D.* [*Ceratodictya*] *cinctum*, *D.* [*Calathospongia?*] *saeculus*, *Ectenodictya* (*Lyrodictya?*) *Burlingtonensis*, *Lyrodictya Romingeri*, *Phragmodictya patelliformis*, *Cleodictya gloriosa*, *C. Mohri* *Physospongia Colletti.*

21. L. LESQUEREUX. *Description of the Coal Flora of the Carboniferous Formation in Pennsylvania and throughout the United States.* (Second Geol. Surv. Penn. Rept. P, vol. iii, p. 827.)

The author, regarding the fossils known as DICTYOPHYTON as marine algae, describes a new form under the name *Dictyophyton ramosum.* The species is considered at length in the following pages under the name, *Botryodictya ramosa.*

1886.

22. R. P. WHITFIELD. *Notice of a New Fossil Body, probably a Sponge related to Dictyophyton.* (Bull. No. 8, Amer. Mus. Nat. Hist. pp. 346–348, pl. XXXV, figs. 1–9.)

Under the generic name RHOMBODICTYON, are described two species from the Hudson River slates at Kenwood, near Albany, N. Y., of somewhat irregularly globose outline and having a surface marked by parallel raised lines crossed by flexuous oblique striae. The general aspect of these fossils suggests their spongous nature, but there is no satisfactory evidence of relationship to the Dictyosponges.

1887.

23. GEORGE J. HINDE. *A Monograph of the British Fossil Sponges, Part 1, pp. 1–92, pls. i–viii.*

The author erects the family PROTOSPONGIDÆ as a member of the order *Dictyonina*. It is made to include PROTOSPONGIA, Salter, PHORMOSELLA and PLECTODERMA, Hinde, "and possibly also some of the forms included under *Dictyophyton*, Hall" (p. 90). It is also observed that "by some authors the spicules are believed to be free from each other and thus of a Lyssacine character." On plate ii, are given figures (4, a–c) of *Dictyophyton* [*Dictyospongia*] *Danbyi*, McCoy (sp.), from the Ludlow beds of Westmoreland.

24. JAMES HALL. *Note on the Occurrence of the Dictyospongidæ in the State of New York.* (Sixth Ann. Rept. N. Y. State Geologist, pp. 36–38, map.)

Gives a table showing the distribution of the American species and a map exhibiting the geographical occurrence of specimens in western New York as known at that date.

1887.

25. F. E. SCHULZE. *Report on the Hexactinellida collected by H. M. S. Challenger during the years 1873–1876, p. 63.*

Reference is made to the determinations and suggestions by WHITFIELD and DAWSON as to the hexactinellid structure of some of the DICTYOSPONGIDÆ, and the announcement by WALCOTT of the spongous character of CYATHOPHYCUS. These forms are considered as "fossil EUPLECTELLIDÆ."

1888.

26. J. W. DAWSON. *New Species of Fossil Sponges from Little Métis, Province of Quebec, Canada.* (Canadian Record of Science, April, pp. 49–59.)

The substance of this paper is included and expanded in No. 30, with similar observations upon DICTYOPHYTON.

27. GEORGE J. HINDE. *Notes on Sponges from the Quebec group at Métis and from the Utica shale.* (Canadian Record of Science, April, pp. 59–68.)

The author remarks that both names CYATHOPHYCUS and DICTYOPHYTON, are unsuitable for sponges and that it might prove advisable to reinstate the name HYDNOCERAS, Conrad.

28 GEORGE J. HINDE. *A Monograph of the British Fossil Sponges, Part II, pp. 93–188, pl. ix.*

A description is given of the genus DICTYOPHYTON (p. 126), and of *D. Daubyi*, McCoy (sp.) (p. 128). It is observed "that the genus TETRAGONIS, Eichwald, is merely a synonym of ISCHADITES, Murch., and its characters markedly differ from those of DICTYOPHYTON."

1889.

29. CHARLES E. BEECHER. *Brachiospongidæ; a Memoir on a group of Silurian Sponges.* (Mem. Peabody Mus. Yale Univ. vol. 2, pt. 1, pp. 1–28, pls. i–vi.)

Under the family DICTYOSPONGIDÆ, Hall, are included (p. 16) the genera PROTOSPONGIA and CYATHOPHYCUS, together with HYDNOCERAS and its allies.

30. J. W. DAWSON. *New Species of Fossil Sponges from the Siluro-Cambrian at Little Métis, on the Lower St. Lawrence; with notes by Dr. G. J. Hinde.* (Trans. Roy. Soc. Canada, vol. VII, Sect. iv, pp. 31–55, pl. iii.)

In this work a number of remarkable forms of the PROTOSPONGIDÆ are described, together with other sponges whose structure is too imperfectly known to ensure their position among recognized families. A distinction is pointed out between the structure of CYATHOPHYCUS and the *Uphantænia* (*Physospongia*) *Dawsoni*, but that genus is ascribed to the DICTYOSPONGIDÆ, and referred to the sub-order *Dictyonina*. In a note upon page 39, DR. HINDE suggests that there is good reason for regarding PROTOSPONGIA and allied palæozoic genera as Lyssacine, rather than Dictyonine hexactinellids.

31. M. NEUMAYR. *Die Stämme des Thierreichs, p. 228.*

The author places DICTYOPHYTON among the Dictyonine hexactinellids but suggests that it may be Lyssacine.

32. E. O. ULRICH. *Preliminary Description of New Lower Silurian Sponges.* (American Geologist, vol. 3, p. 233.)

The species *Rauffella filosa*, Ulrich, of the Trenton group, which the author here suggests may be a Dictyosponge, has not the characters of this family.

1890.

33. JAMES HALL. *Fossil Dictyospongidæ of the Devonian and Carboniferous Formations: New Forms of Dictyospongidæ from the rocks of the Chemung group.* (Ninth Ann. Rept. N. Y. State Geol. pp. 56–60; Also published in Bull. Geol. Soc. America, vol. 1, p. 22; and in Forty-third Ann. Rept. N. Y. State Mus. pp. 258–262.)

In this paper two new genera are introduced: ACTINODICTYA and CRYPTODICTYA. The following species are described for the first time:

Dictyophyton sceptrum.
D. vascellum.
D. Randalli.
D. scitum.
D. Amalthea.
D. tomaculum.
D? (Phragmodictya) Halli.
Actinodictya placenta.
Cryptodictya Alleni.

1892.

34. CLEMENS SCHLÜTER. *Protospongia rhenana.* (Zeitsch. der Deutsch. Geolog. Gesellsch., pp. 615–618, figure.)

Under the above name is described a species from the lower Devonian Hunsrück slates, near Gemünden, which is represented by a large, quite incomplete specimen, showing quadrate reticulations in a diminishing series. The quadrules appear to be formed by bundles of spicular filaments associated with stauractins. The species is undoubtedly a Dictyosponge but its generic relations are uncertain.

1893.

35. N. H. WINCHELL and C. SCHUCHERT. *Sponges, Graptolites and Corals from the Lower Silurian of Minnesota.* (Extract from vol. iii, Final Report of the Minnesota Geol. Surv. p. 75, pl. F, figs. 16–20.)

Rauffella filosa, Ulrich, is redescribed and placed under the family DICTYSPONGIDÆ. It is asserted by RAUFF that this is not an organism.

36. HERMANN RAUFF. *Palæospongiologie, Part I, Lieferungen 1–4, pp. 1–232.* (Palaeontographica, vol. xl.)

In this comprehensive undertaking, which plans an exhaustive treatise of all fossil sponges, the author opens with an elaborate bibliography of the subject, embracing 591 references up to the year 1892, following this with an analysis of the work of those writers whose investigations have been of especial influence in the study of these organisms. A long chapter on the

morphology of the sponges, both of their soft and skeletal parts, with abundant illustration, is constructed with especial reference to the fossil forms. In the systematic treatment of these bodies the suborder *Lyssacina* is made to include eight families, as follows: PROTOSPONGIDÆ, Hinde, DICTYOSPONGIDÆ, Hall, PLECTOSPONGIDÆ, Rauff, EUPLECTELLIDÆ, Gray, ASCONEMATIDÆ, Schulze, ROSSELLIDÆ, Schulze, HYALONEMATIDÆ, Schulze, BRACHIOSPONGIDÆ, Beecher.

The author is the first to establish distinctive characters between the PROTOSPONGIDÆ and the DICTYOSPONGIDÆ and to suggest the probability that CYATHOPHYCUS, PLECTODERMA and PHORMOSELLA are not safely placed with either of these families; hence the erection of the family PLECTOSPONGIDÆ. The final chapter in this portion of the work relates to the mode of preservation of the fossil sponges.

1894.

37. HERMANN RAUFF. *Palaeospongiologie, Part 1, Lieferungen 5, 6, pp. 233–346, pls. i–xvii.* (Palaeontographica, vol. xl.)

This instalment of the same work is devoted to descriptions of palaeozoic species. The various forms of the PROTOSPONGIDÆ described by DAWSON, and the PLECTOSPONGIDÆ (CYATHOPHYCUS, TEGANIUM), are described and in many instances illustrated with new figures. On page 249, under the family DICTYOSPONGIDÆ, is described as *Dictyophytra* (?) *Walcotti*, Rauff, a new species from the Utica slate at Holland Patent, N. Y. DICTYOPHYTRA is evidently a proposed modification of the term DICTYOPHYTON; as a substitute for the latter it is unobjectionable etymologically and in its application to these fossils, but it is objectionable historically if used in the broad sense in which the term DICTYOPHYTON has heretofore been applied. The definition of the genus is deferred to a later part of the work and its value, therefore, can not be determined until the author makes known upon what forms of "*Dictyophyton*" the genus is based.

Dictyophytra (?) *Walcotti*, (pl. iv, figs. 1, 2) is founded upon the fragment of a large, coarse-meshed species, quite distinct in size and texture from its associate, *Cyathophycus reticulatus*. That it is a true Dictyosponge, however, and not a CYATHOPHYCUS, can not be regarded as established.

The 7th and 8th Lieferungen of this work, dated 1895, contain nothing especially relating to the Hexactinellida.

We greatly regret that Dr. RAUFF's observations upon the Devonian and Carboniferous Dictyosponges have not been received as this volume goes to press.

38 JOHN M. CLARKE. *New or Rare Species of Fossils from the horizons of the Livonia Salt Shaft.* (Thirteenth Ann. Rept. N. Y. State Geologist, vol. 1, p. 177, pl. IV, figs. 19–22. Also in Forty-seventh Annual Report N. Y. State Museum, p. 371.)

Describes as *Hyalostelia? Marcellia*, a species from the bituminous shales of the Marcellus epoch, the generic characters of which are quite obscure, though the presence of broad unresolvable spicules of great size and having the form of blades of grass, indicates a structure unlike any heretofore described. The original form of the species is unknown.

1895.

39. K. A. v. ZITTEL. *Grundzüge der Palaeontologie, pp. 52 et seq.*

The author here recognizing the two suborders of the HEXACTINELLIDA, *Lyssacina* and *Dictyonina*, places under the former the three families, PROTOSPONGIDÆ, DICTYOSPONGIDÆ and PLECTOSPONGIDÆ. The definition of each of these families is essentially that given by RAUFF.

1896.

40. K. A. VON ZITTEL. *Text-book of Palaeontology; Translated and edited by Charles R. Eastman, pp. 54 et seq.*

The subject is here treated as in No. 39, of which this is a translation and enlargement.

41. GEORGE H. GIRTY. *A Revision of the Sponges and Coelenterates of the Lower Helderberg Fauna of New York.* (Fourteenth Ann. Rept. N. Y. State Geologist, pp. 258 *et seq.* Also Forty-eighth Annual Report N. Y. State Museum, p. 261.)

For certain hexactinellid spicules from the Lower Helderberg rocks the author introduces the generic term LYSACTINELLA and makes use of two specific names, one applied to smooth spicules, the other to those having thorny rays.

1897.

42. FERDINAND ROEMER and FRITZ FRECH. *Lethaea Geognostica, 1 Theil; Lethaea Palaeozoica, 1 Band*

This is a continuation of ROEMER's work, the plates of which appeared in 1876 and the first instalment of the text in 1880. So far as the Dictyosponges are concerned no additions or changes are made from the treatment of the genera as cited under No. 8.

CLASSIFICATION OF THE DICTYOSPONGIDÆ.

The manifold variations in form expressed by these sponges are accompanied by certain structural diversities which, however, do not lead far a-field from the comprehensive definition elsewhere given of the indicial characters of the Family. It has been, in our judgment, wise not to endow any of these structural characters with so high value as to necessitate the erection of additional Family terms, and experience indicates that few thin-walled siliceous sponges of the Devonian and Carboniferous faunas will fail to find a place within the limits of this Family, DICTYOSPONGIDÆ. The structural variations of chief importance are herewith summarized and utilized as the basis of a subordinate classification.

Subfamily I.

DICTYOSPONGIINÆ.

Simple, vase-shaped or elongate, smooth, prismatic, nodose or annulated forms with obconical base; with basal prostalia; with or without marginalia; no basal disk; primitive form a regular obcone.

Dictyospongia,
(?) Lysactinella,
Hydriodictya,
Prismodictya,
Gongylospongia,
Hydnoceras,
(?) Tylodictya,
Helicodictya,
Rhabdosispongia,
Ceratodictya,
Clathrospongia,
Lebedictya,
Lyrodictya,
(?) Mastodictya.

BOTRYODICTYA, which appertains to this group in its principal characters, is aberrant in the possession of a more or less complete diaphragm, not at the base but near the middle of the sponge, just below the nodiferous body.

Subfamily II.

THYSANODICTYINÆ.

Cylindrical or expanding cups, with basal disk and periloph.

Thysanodictya,
Arystidictya,
Phragmodictya,
(?) Griphodictya.

Subfamily III.

CALATHOSPONGIINÆ.

Expanding forms with smooth, tufted or nodose surface and obtuse basal extremity without diaphragm or periloph.

Calathospongia, Clepsydrospongia,
Thamnodictya, Cleodictya.

The genus CLEPSYDROSPONGIA presents, in its tufted nodose surface, the aspect of HYDNOCERAS, but is as broad at the basal, as at the apertural extremity.

CLEODICTYA is tentatively placed in this division on account of its apparently broad base.

Subfamily IV.

PHYSOSPONGIINÆ.

Stout cups with a single or double series of strong horizontal and vertical spicular bundles, tufted at their intersections; meshes covered by thin bullate expansions or depressions of the reticulum (parenchymalia); no basal disk (?).

Physospongia, Roemerispongia.

Subfamily V.

HYPHANTÆNIINÆ.

Large saucer-shaped fronds composed of a single series of ligulate concentric and radial reticulating bands; meshes partially closed by parenchymal reticulum; attached by basal apex (basalia?).

Hyphantænia.

Subfamily VI.

HALLODICTYINÆ.

Irregularly growing, explanate or frondiform sponges, with smooth or tufted nodate surface.

Hallodictya, Cryptodictya.
Actinodictya,

Subfamily VII.

AGLITHODICTYINÆ.

Discoid sponges, rapidly expanding and contracting; attached by apex (basalia?); osculum large.

Aglithodictya.

Synoptic List of Genera and Species of the Dictyospongidæ.

Subkingdom

SPONGIÆ.

Class

SILICEA, Gray.

Order

HEXACTINELLIDA, O. Schmidt.

Suborder

LYSSACINA, Zittel.

Family

DICTYOSPONGIDÆ, Hall.

Subfamily **DICTYOSPONGIINÆ**, subfam. nov.

Genus **Dictyospongia**, gen. nov.

D. Danbyi, McCoy (sp.).
D.? Marcellia, Clarke (sp.).
D. haplea, sp. nov.
D. sceptrum, Hall (sp.).
D. lophura, sp. nov.
D. charita, sp. nov.
D. eumorpha, sp. nov.
D. siræa, sp. nov.
D. Almondensis, sp. nov.
D. bacteria, sp. nov.
D. Morini, Barrois (sp.).
D. cylindrica, Whitfield (sp.).
D. stylina, sp. nov.

Genus **Lysactinella**, Girty.

L. Gebhardi, Girty.
L. perelegans, Girty.

Genus **Hydriodictya**, gen. nov.

H. patula, Hall (sp.).
H. cylix, sp. nov.
H. nephelia, sp. nov.

Genus **Prismodictya**, gen. nov.

P. palæa, sp. nov.
P. telum, Hall (sp.).
P. banano, sp. nov.
P. amicitiæ, sp. nov.

P. baculum, Hall (sp.).
P. spectabilis, sp. nov.
P. parallela, Hall (sp.).
P. prismatica, Hall (sp.).
P. Allegania, sp. nov.
P. choanea, sp. nov.
P. corynia, sp. nov.
P. filitextilis, Hall (sp.).
P. aulophia, sp. nov.
P. ptionia, sp. nov.
P. cercidea, sp. nov.
P. cithara, sp. nov.
P. narthecia, sp. nov.
P. Conradi, Hall (sp.).
P. polyhedra, sp. nov.

Genus **Gongylospongia**, gen. nov.

G. Marshi, sp. nov.

Genus **Hydnoceras**, Conrad.

H. legatum, sp. nov.
H. gracile, sp. nov.
H. tuberosum, Conrad.
H. tuberosum,
var. glossema, var. nov.
H. Bathense, sp. nov.
H. botrœdema, sp. nov.
H. Avoca, sp. nov.
H. phymatodes, sp. nov.
H. hypastrum, sp. nov.
H. eutheles, sp. nov.
H. multinodosum, sp. nov.
H. Lutheri, sp. nov.
H. rhopalum, sp. nov.
H. variabile, sp. nov.
H. nodosum, Hall (sp.).
H. anthracis, sp. nov.
H. eumeces, sp. nov.
H. Barroisi, nom. nov.
H. Jeanmontense, sp. nov.

Genus **Botryodictya**, gen. nov.

B. ramosa, Lesquereux (sp.).
B. (or Tylodictya) sp. nov.

Genus **Tylodictya**, gen. nov.

T. Warrenensis, sp. nov.
T.? tenuis, Hall (sp.).

Genus **Helicodictya**, gen. nov.

H. trypania, sp. nov.
H.? Concordia, sp. nov.
H.? Scio, sp. nov.

Genus **Rhabdosispongia**, gen. nov.

R. Amalthea, Hall (sp.).
R. Condroziana, sp. nov.

Genus **Ceratodictya**, gen. nov.

C. Carpenteriana, sp. nov.
C. cincta, Hall (sp.).
C. zonata, sp. nov.
C. annulata, Hall (sp.).
C. centeta, sp. nov.

Genus **Clathrospongia**, Hall.

C.? Hamiltonensis, Hall (sp.).
C. fenestrata, Hall.
C. vascellum, Hall.
C.? tomaculum, Hall.
C. irregularis, Hall.
C.? desmia, sp. nov.
C. abacus, Hall.
C. caprodonta, sp. nov.

Genus **Lebedictya**, gen. nov.

L. crinita, sp. nov.

Genus **Lyrodictya**, Hall.

L. Romingeri, Hall.
L.? Burlingtonensis, Hall (sp.).

Genus **Mastodictya**, gen. nov.

M. osculata, sp. nov.

SUBFAMILY **THYSANODICTYINÆ**, subfam. nov.

Genus **Thysanodictya**, gen. nov.

T. Edwin-Halli, Hall (sp.).
T. pœcilus, sp. nov.
T. rudis, Hall (sp.).
T. Randalli, Hall (sp.).
T. saccus, sp. nov.
T. Johnstoni, sp. nov.
T. quasillum, sp. nov.
T. scyphina, sp. nov.
T. hermenia, sp. nov.
T. apleta, sp. nov.
T. turricula, sp. nov.
T. expansa, Hall (sp.).

Genus **Phragmodictya**, Hall.

P. catilliformis, Whitfield (sp.).
P.? crebristriata, Hall.
P.? lineata, Hall.

Genus **Arystidictya**, gen. nov.

A. elegans, sp. nov.
A. nodifera, sp. nov.

Genus **Aclœodictya**, gen. nov.

A. marsipus, sp. nov.
A.? excentrica, Hall (sp.).

Genus **Griphodictya**, gen. nov.

G. epiphanes, sp. nov.

SUBFAMILY **CALATHOSPONGIINÆ**, subfam. nov.

Genus **Calathospongia**, gen. nov.

C. Redfieldi, Hall (sp.).
C. carceralis, sp. nov.
C. Carlli, sp. nov.
C. Tiffanyi, sp. nov.
C.? sacculus, Hall (sp.).
C. amphorina, sp. nov.
C.? magnifica, sp. nov.

Genus **Thamnodictya**, Hall.

T. Newberryi, Hall.
T. Ortoni, sp. nov.

Genus **Clepsydrospongia**, gen. nov.

C. matutina, sp. nov.

Genus **Cleodictya**, Hall.

C. Claypolei, sp. nov.
C. Mohri, Hall.
C. gloriosa, Hall.

Subfamily **PHYSOSPONGIINÆ**, subfam. nov.

Genus **Physospongia**, Hall.

P. Dawsoni, Whitfield (sp.).
P. alternata, Hall.
P. Colletti, Hall.
P. multibursaria, sp. nov.

Genus **Roemerispongia**, gen. nov.

R. Gerolsteinensis, F. Roemer (sp.).

Subfamily **HYPHANTÆNIINÆ**, subfam. nov.

Genus **Hyphantænia**, Vanuxem.

H. Chemungensis, Vanuxem.

Subfamily **HALLODICTYINÆ**, subfam. nov.

Genus **Hallodictya**, gen. nov.

H. Sciensis, sp. nov.
H. Cottoniana, sp. nov.

Genus **Actinodictya**, Hall.

A. placenta, Hall.

Genus **Cryptodictya**, Hall.

C. Alleni, Hall.

Subfamily **AGLITHODICTYINÆ**, subfam. nov.

Genus **Aglithodictya**, gen. nov.

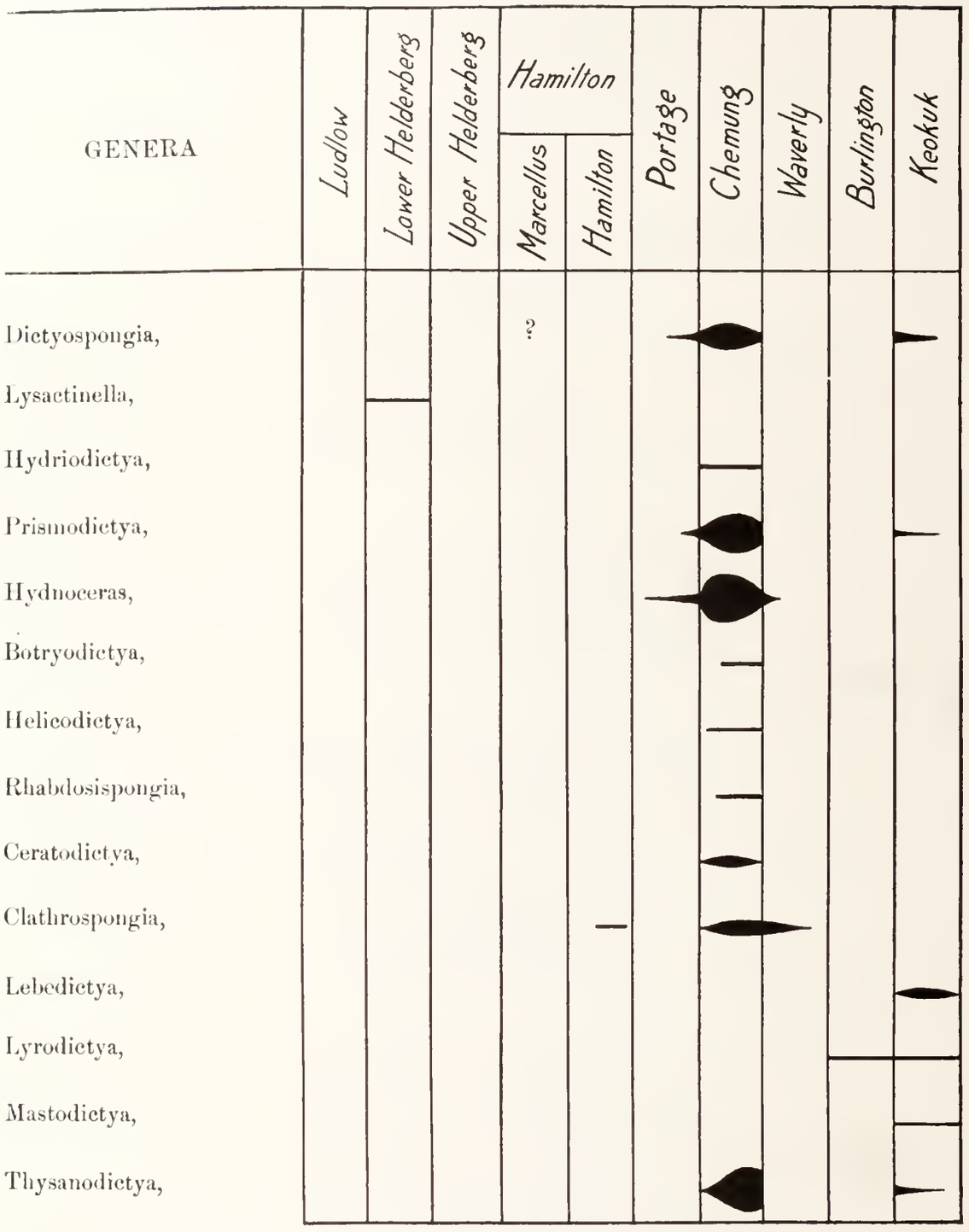
A. nummulina, sp. nov.

Dubitandæ sedis.

? Genus **Ectenodictya**, Hall.

? E. implexa, Hall.

Generic Distribution of the Dictyospongidæ.



Generic Distribution of the DICTYOSPONGIDÆ (*Concluded*).

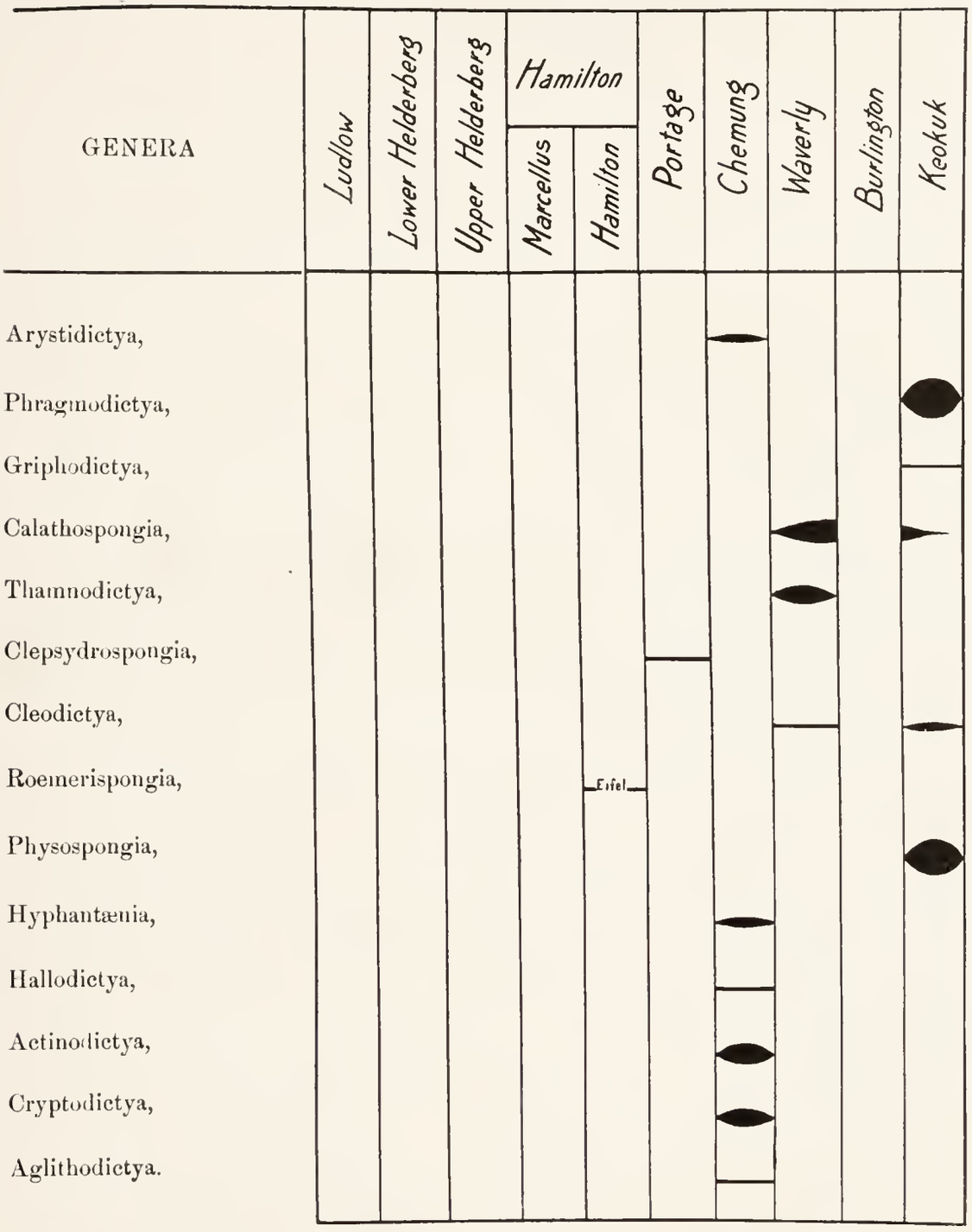


Table Showing the Geological Distribution of the Dictyospongidæ.

	NAME OF SPECIES.	Ludlow beds, England.	Lower Helderberg group.	Upper Helderberg group.	Hamilton Group.		Portage group.	Chemung group.	Waverly group.	Burlington limestone.	Keokuk group.
					Marcellus shales.	Hamilton shales.					
		1	2	3	4	5	6	7	8	9	10
1	Dictyospongia Danbyi, McCoy (sp.)	x	..	..	..	..	..	..	..	..	..
2	D.? Marcellia, Clarke (sp.)	..	..	..	x	..	..	..	..	..	..
3	D. haplea, sp. nov	..	..	..	..	..	x	..	..	..	..
4	D. sceptrum, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
5	D. lophura, sp. nov	..	..	..	..	..	..	x	..	..	..
6	D. charita, sp. nov	..	..	..	..	..	..	x	..	..	..
7	D. eumorpha, sp. nov	..	..	..	..	..	..	x	..	..	..
8	D. siræa, sp. nov	..	..	..	..	..	..	x	..	..	..
9	D. Almondensis, sp. nov	..	..	..	..	..	..	x	..	..	..
10	D.? bacteria, sp. nov	..	..	..	..	..	..	x	..	..	..
11	D. stylina, sp. nov	..	..	..	..	..	..	..	..	..	x
12	D. cylindrica, Whitfield (sp.)	..	..	..	..	..	..	..	..	..	x
13	D. Morini, Barrois (sp.)	..	..	..	..	..	..	x*	..	..	..
14	Lysactinella Gebhardi, Girty	..	x	..	..	..	..	..	..	..	..
15	L. perelegans, Girty	..	x	..	..	..	..	..	..	..	..
16	Hydriodictya patula, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
17	H. cylix, sp. nov	..	..	..	..	..	..	x	..	..	..
18	H. nephelia, sp. nov	..	..	..	..	..	..	x	..	..	..
19	Prismodictya palæa, sp. nov	..	..	..	..	..	x	..	..	..	..
20	P. telum, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
21	P. baculum, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
22	P. spectabilis, sp. nov	..	..	..	..	..	..	x	..	..	..
23	P. parallela, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
24	P. prismatica, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
25	P. Allegania, sp. nov	..	..	..	..	..	..	x	..	..	..
26	P. choanea, sp. nov	..	..	..	..	..	..	x	..	..	..
27	P. corynia, sp. nov	..	..	..	..	..	..	x	..	..	..
28	P. filitextilis, Hall	..	..	..	..	..	..	x	..	..	..
29	P. banano, sp. nov	..	..	..	..	..	..	x	..	..	..
30	P. amicitiæ, sp. nov	..	..	..	..	..	..	x	..	..	..
31	P. aulophia, sp. nov	..	..	..	..	..	..	x	..	..	..
32	P. ptionia, sp. nov	..	..	..	..	..	..	x	..	..	..
33	P. cercidea, sp. nov	..	..	..	..	..	..	x	..	..	..
34	P. cithara, sp. nov	..	..	..	..	..	..	x	..	..	..
35	P. narthecia, sp. nov	..	..	..	..	..	..	x	..	..	..
36	P. Conradi, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
37	P. polyhedra, sp. nov	..	..	..	..	..	..	..	..	..	x
38	Gongylospongia Marshi, sp. nov	..	..	..	..	..	..	x	..	..	..
39	Hydnoceras legatum, sp. nov	..	..	..	..	..	x	..	..	..	..
40	H. gracile, sp. nov	..	..	..	..	..	x	..	..	..	..

*From the Psammites du Condroz, France.

Table Showing the Geological Distribution of the DICTYOSPONGIDÆ *(Cont'd)*.

		1	2	3	4	5	6	7	8	9	10
41	H. tuberosum, Conrad	..	..	..	..	..	..	X	..	..	..
42	H. tuberosum, var. glossema, var. nov	..	..	..	..	..	..	X	..	..	..
43	H. Bathense, sp. nov	..	..	..	..	..	..	X	..	..	..
44	H. botrœdema, sp. nov	..	..	..	..	..	..	X	..	..	..
45	H. Avoca, sp. nov	..	..	..	..	..	..	X	..	..	..
46	H. phymatodes, sp. nov	..	..	..	..	..	..	X	..	..	..
47	H. hypastrum, sp. nov	..	..	..	..	..	..	X	..	..	..
48	H. eutheles, sp. nov	..	..	..	..	..	X	X	..	..	..
49	H. multinodosum, sp. nov	..	..	..	..	..		X	..	..	..
50	H. Lutheri, sp. nov	..	..	..	..	..	..	X	..	..	..
51	H. rhopalum, sp. nov	..	..	..	..	..	..	X	..	..	..
52	H. variabile, sp. nov	..	..	..	..	..	..	X	..	..	..
53	H. nodosum, Hall (sp.)	..	..	..	..	..	..	X	..	..	..
54	H. anthraeis, sp. nov	..	..	..	..	..	..	X	..	..	..
55	H. eumeces, sp. nov	..	..	..	..	..	..	X	..	..	..
56	H. Barroisi, nom. nov	..	..	..	..	..	..	X*	..	..	..
57	H. Jeumontense, sp. nov	..	..	..	..	..	..	X*	..	..	..
58	Botryodictya ramosa, Lesquereux (sp.)	..	..	..	..	..	..	X	..	..	..
59	B. (or Tylodictya) sp. nov	..	..	..	..	..	..	X	..	..	..
60	Tylodictya Warrenensis, sp. nov.	..	..	..	..	..	..	..	X	..	..
61	T.? tenuis, Hall (sp.)	..	..	..	..	..	..	..	X	..	..
62	Helicodictya trypania, sp. nov	..	..	..	..	..	..	X	..	..	..
63	H.? Concordia, sp. nov	..	..	..	..	..	..	X	..	..	..
64	H.? Seio, sp. nov	..	..	..	..	..	..	X	..	..	..
65	Rhabdosispongia Amalthea, Hall (sp.)	..	..	..	..	..	..	X	..	..	..
66	R. Condroziana, sp. nov	..	..	..	..	..	..	X*	..	..	..
67	Ceratodictya Carpenteriana, sp nov	..	..	..	..	..	..	X	..	..	..
68	C. cincta, Hall (sp.)	..	..	..	..	..	..	X	..	..	..
69	C. zonata, sp. nov	..	..	..	..	..	..	X	..	..	..
70	C. annulata, Hall (sp.)	..	..	..	..	..	..	X	..	..	..
71	C. centeta, sp. nov	..	..	..	..	..	..	X	..	..	..
72	Clathrospongia (?) Hamiltonensis, Hall (sp.)	..	..	..	..	X	..	..	..	..	..
73	C. fenestrata, Hall	..	..	..	..	..	..	X	..	..	..
74	C. vascellum, Hall	..	..	..	..	..	..	X	..	..	..
75	C ? tomaculum, Hall	..	..	..	..	..	..	X	..	..	..
76	C. irregularis, Hall	..	..	..	..	..	..	X	..	..	..
77	C.? desmia, sp. nov	..	..	..	..	..	..	X	..	..	..
78	C. abacus, Hall	..	..	..	..	..	..	..	X	..	..
79	C. caprodonta, sp. nov	..	..	..	..	..	..	..	X	..	..
80	Lebedictya crinita, sp. nov	..	..	..	..	..	..	..	..	..	X
81	Lyrodictya Romingeri, Hall	..	..	..	..	..	..	..	..	..	X
82	L ? Burlingtonensis, Hall (sp.)	..	..	..	..	..	..	..	..	X	..
83	Mastodictya osculata, sp. nov	..	..	..	..	..	..	..	..	..	X
84	Thysanodictya Edwin-Halli, Hall (sp)	..	..	..	..	..	..	X	..	..	..
85	T. pœcilus, sp. nov	..	..	..	..	..	..	X	..	..	..
86	T. rudis, Hall (sp)	..	..	..	..	..	..	X	..	..	..
87	T. Randalli, Hall (sp.)	..	..	..	..	..	..	X	..	..	..

* From the Psammites du Condroz, France.

Table Showing the Geological Distribution of the DICTYOSPONGIDÆ (*Concl'd*).

		1	2	3	4	5	6	7	8	9	10
88	T. saccus, sp. nov.	..	..	..	..	..	..	X	..	..	..
89	T. Johnstoni, sp. nov	..	..	..	..	..	..	X	..	..	..
90	T. quasillum, sp. nov	..	..	..	..	..	..	X	..	..	..
91	T. scyphina, sp. nov.	..	..	..	..	..	..	X	..	..	..
92	T. hermenia, sp. nov.	..	..	..	..	..	..	X	..	..	..
93	T. apleta, sp. nov	..	..	..	..	..	..	X	..	..	..
94	T. turricula, sp. nov	..	..	..	..	..	..	X	..	..	..
95	T. expansa, Hall (sp.)	..	..	..	..	..	..	..	X	..	..
96	Phragmodictya catilliformis, Whitfield (sp.)	..	..	..	..	..	..	..	..	..	X
97	P.? crebristriata, Hall	..	..	..	..	..	..	..	..	..	X
98	P.? lineata, Hall	..	..	..	..	..	..	..	..	..	X
99	Acleodictya marsipus, sp. nov.	..	..	..	..	..	..	..	..	..	X
100	A.? excentrica, Hall (sp.)	..	..	..	..	..	..	..	..	..	X
101	Arystidictya elegans, sp. nov	..	..	..	..	..	..	X	..	..	..
102	A. nodifera, sp. nov	..	..	..	..	..	..	X	..	..	..
103	Griphodictya epiphanes, sp. nov.	..	..	..	..	..	..	..	..	..	X
104	Calathospongia Redfieldi, Hall (sp.)	..	..	..	..	..	..	..	X	..	..
105	C. carceralis, sp. nov	..	..	..	..	..	..	..	X	..	..
106	C. Carlli, sp. nov	..	..	..	..	..	..	..	X	..	..
107	C. Tiffanyi, sp. nov	..	..	..	..	..	..	..	X	..	..
108	C.? sacculus, Hall (sp.)	..	..	..	..	..	..	..	X	..	..
109	C. amphorina, sp. nov.	..	..	..	..	..	..	..	..	..	X
110	C.? magnifica, sp. nov	..	..	..	..	..	..	..	..	..	X
111	Thamnodictya Newberryi, Hall.	..	..	..	..	..	..	..	X	..	..
112	T. Ortoni, sp. nov	..	..	..	..	..	..	..	X	..	..
113	Clepsydrospongia matutina, sp. nov.	..	..	..	..	..	X	..	..	..	..
114	Cleodictya Claypolei, sp. nov.	..	..	..	..	..	..	..	X	..	..
115	C. gloriosa, Hall	..	..	..	..	..	..	..	..	..	X
116	C. Mohri, Hall	..	..	..	..	..	..	..	..	..	X
117	Roemerispongia Gerolsteinensis, Roemer (sp.)	..	..	..	..	X*	..	..	..	..	..
118	Physospongia Dawsoni, Whitfield (sp.)	..	..	..	..	..	..	..	..	..	X
119	P. Colletti, Hall	..	..	..	..	..	..	..	..	..	X
120	P. alternata, Hall	..	..	..	..	..	..	..	..	..	X
121	P. multibursaria, sp. nov	..	..	..	..	..	..	..	..	..	X
122	Hyphantænia Chemungensis, Vanuxem	..	..	..	..	..	..	X	..	..	..
123	Hallodictya Sciensis, sp. nov	..	..	..	..	..	..	X	..	..	..
124	H. Cottoniana, sp. nov	..	..	..	..	..	..	X	..	..	..
125	Actinodictya placenta, Hall	..	..	..	..	..	..	X	..	..	..
126	Cryptodictya Alleni, Hall	..	..	..	..	..	..	X	..	..	..
127	Aglithodictya numulina, sp. nov.	..	..	..	..	..	..	X	..	..	..
128	Ectenodictya implexa, Hall	..	..	..	..	..	..	..	X	..	..

* From the middle Devonian of Gerolstein in the Eifel.

DESCRIPTIONS

of Genera and Species.

Of the considerable number of genera here discussed, several are represented by many species whose differentials may seem obscure or, to some students, overestimated. In fixing specific values within a given genus of such variable organisms, it has been found necessary to depend very largely upon variations in form as the paramount specific character. If, in this practise, what may seem, in such prolific genera as Prismodictya, Hydnoceras and Thysanodictya, to be traits of lesser value, are dignified with specific distinction, it is because such distinctions are, in the existing state of our knowledge, the truest expression of these relations, as well as the most convenient denomination. To future investigations with the aid of more extensive material, must be assigned the determination of fundamental type forms, in terms of which all of these manifold variations may be expressed.

SPECIES OF THE SILURIAN.

DICTYOSPONGIA, gen. nov.

(For description see page 72.)

Dictyospongia Danbyi, McCoy (sp.).

1855. *Tetragonis Danbyi*, McCoy. British Palaeozoic Fossils, p. 62, pl. 1 D, figs. 7, 8.

1880. *Tetragonis Danbyi*, F. Roemer. Lethæa Palæozoica, Part 1, p. 304.

1883. *Dictyophyton Danbyi*, Hinde. Cat. Fossil Sponges British Museum, p. 131.

1887. *Dictyophyton Danbyi*, Hinde. Monogr. British Fossil Sponges, Part 1, pl. ii, figs. 4 a–c.

1888. *Dictyophyton Danbyi*, Hinde. Monogr. British Fossil Sponges, Part 2, p. 128.

"Sponges subovate or sub-conical in form, growing from an obtuse basal point, without stem, root or point of attachment; the base is flattened or convex, the greatest width in some specimens is just above the base, in others about half the height of the sponge, from this it gradually tapers to the

summit which appears to have been open. The specimens vary between 23 and 30 mm. in height, and from 14 to 17 mm. in width.

"The sponge-wall appears to have been smooth and even; the larger areas of the rectangular mesh-work are marked out by more prominent, vertical and transverse raised lines, and vary from 1.5 to 3 mm. in length, and these are subdivided by finer lines into smaller squares, the sides of which are about .75 mm. in length. In some cases the stronger lines forming the larger squares are nearly parallel from the base to the summit, whilst in others they converge to each other towards the base.

"No spicular structure whatever has been preserved in any of the specimens yet discovered, which are merely casts in a matrix of micaceous sandstone. No structure can be detected in the interior of the specimens." (HINDE, *op. cit.* 1888.)

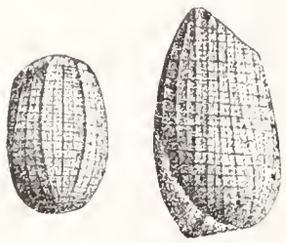


FIGURE 10. McCOY'S figures of *Tetragonis Danbyi*.

The foregoing description was based upon McCOY's original specimens and his figures are here reproduced. These show an obscurely prismatic form which is not reproduced in the figures of the species given by HINDE nor mentioned in his description. This species, a fossil of rare occurrence, is the oldest known representative of the DICTYOSPONGIDÆ.

Localities. From the upper Ludlow rocks at Brigsteer, Benson, Underbarrow and Kendal, Westmoreland, England.

SPECIES OF THE DEVONIAN

SPECIES OF THE LOWER HELDERBERG GROUP.

LYSACTINELLA, Girty.

1896. *Lysactinella*, Girty. Fourteenth Ann. Report N. Y. State Geologist, pp. 258–261, pl. 1.

This genus has been recently described from free spicules obtained by etching the silica-bearing limestones of the Lower Helderberg group in Albany county, N. Y. Very little is yet known of the form of the sponge body in either of the two species established. Mr. GIRTY speaks of one species, *L. Gebhardi*, as being flattened spherical, but of this as probably a quite accidental shape due to compression and distortion. The spicules of this species, so far as isolated, are smooth forms, mostly hexactine and pentactine. *Lysactinella perelegans* is based on a series of spicules with echinate

arms. There is, from analogy, probably no reason why these smooth and ornate spicules may not have belonged to the same species, but the present distinction will serve a useful purpose until more is learned of these fossils.

SPECIES OF THE HAMILTON GROUP.

DICTYOSPONGIA, gen. nov.

(For description see page 72.)

DICTYOSPONGIA (?) MARCELLIA, Clarke (sp.).

PLATE XLI, FIGS. 8, 9.

1894. *Hyalostelia (?) Marcellia*, Clarke. Thirteenth Ann. Rept. N. Y. State Geologist, vol. 1, p. 177, pl. iv, figs. 19–22.

The specimens upon which this species was based were found at the horizon of the Marcellus shales, in the excavations made at the Livonia salt shaft in Livingston county, N. Y.,* at a depth extending from 812 to 823 feet from the surface. The fossils occur as broad, thin, film-like expansions which, being pyritized, make irregular splotches of discoloration, tingeing the surface of the black bituminous shales a yellowish or greenish hue. Under enlargement these patches are seen to be composed of masses of rod-like and cruciform spicules. The latter are hexactins; many of them, which exhibit four branches on the same plane, show the abbreviated or nodiform remnants of the other two rising in the plane at right angles; in some, however, there seems to be no evidence of more than four rays. With these spicules are found, similarly pyritized, large and coarse spicular bands, flat, straight, thickened on the edges or in the middle, and similar in size and appearance to small blades of grass. These end abruptly at one end but taper to the other, though showing no evidence of terminating in any appliance for attachment.

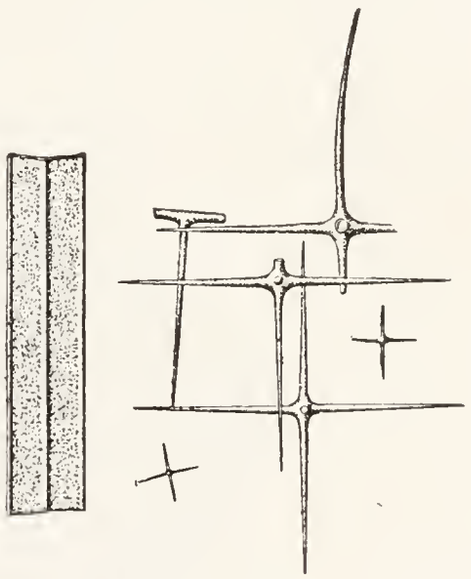


FIGURE 11. Major and minor stauractines of *Dictyospongia? Marcellia*, with portion of ligulate spicule x 30.

There is no evidence that these broad ribbon-like spicular bands are composed of separate spicular rods; on the contrary they are clearly

*A detailed account of these excavations and the succession of the faunas through a vertical section of nearly fifteen hundred feet, is given in the work cited.

distinct and simple bodies. Their association with the cruciform spicules is so close and invariable as to enhance the probability of the organic connection of the two, and yet we do not know a similar structure among the hexactinellids. It has been impossible to gain a conception of the original form of the sponges to which these masses of spicules belong. The generic reference now made of the species is, therefore, quite uncertain.

Locality. In the Marcellus shales of the Hamilton group, Livonia, N. Y.

CLATHROSPONGIA, Hall.

(For description see page 121.)

CLATHROSPONGIA (?) HAMILTONENSIS, Hall (sp.).

PLATE XIV, FIG. 1.

1884. *Dictyophyton Hamiltonense*, Hall. Thirty-fifth Ann. Rept. N. Y. State Museum Natural History, p. 468.

SPONGE broadly cyathiform, regularly and rapidly expanding from the base. Surface apparently regularly obconical, though a sub-prismatic appearance is given to it by the very strong longitudinal spicular bands.

Reticulum characterized by the sharply elevated bands of the first order which produce large quadrules. Near the middle of the cup these primary meshes measure about 12 mm. on each side, but become smaller toward the base of the sponge where the primary bands seem to have been more or less free, but it is not clear whether these were developed into bundles of anchoring spicules independent of the reticulum. The intersections of the primary spicular bands are thickened and distinctly nodate. A second and third series of bands are more or less clearly defined, and the interspaces are very closely reticulated.

The preservation of the single known specimen of this species is peculiar and unique. The entire reticulum is compactly calcified, lying in an argillaceous shale. This calcareous matter seems to have been deposited over the inner surface of the net-work or to have replaced it from within, as traces of the finest spicular lines may be seen over the surfaces of the coarsest bands; this would indicate the posterior position of the finer net-work to the primary longitudinal and transverse bands. The elevation and prominence of the latter convey the impression that in their original condition they were extended into vertical tufts of similar character to the mural lamellae in the typical Chemung forms of CLATHROSPONGIA; the species is therefore referred to this genus until it shall have become more fully known. The lesser spicular bands abound in irregular nodose swellings which may be partially due to imperfect

preservation or to adventitious deposits of calcareous matter upon projecting points.

Dimensions. The length of the specimen is 85 mm., but neither base nor aperture is retained. Its width at the upper extremity is 100 mm.

Locality. In the Hamilton shales, shore of Canandaigua lake, N. Y.

ROEMERISPONGIA, gen. nov.

1883. *Dictyophyton*, Ferd. Roemer. Zeitschr. der Deutsch. Geolog. Gesellsch. vol. 35, p. 704, figs. a, b (p. 706).

Obconical rapidly expanding cups apparently arising from an acute base. Surface divided by strong, subequal vertical spicular bundles, crossed by narrower horizontal bands. The quadrules thus formed are all convex and appear not to be subdivided by subordinate series of spicular bands. Toward the base of the sponge the meshes are less regular than elsewhere.

Type, *Dictyophyton Gerolsteinensis*, F. Roemer.

Roemerispongia Gerolsteinensis, F. Roemer, (sp.).

1883. *Dictyophyton Gerolsteinense*, F. Roemer, *loc. cit.*

In a "*Notiz über die Gattung Dictyophyton*", the late Ferdinand Roemer described, as above cited, an interesting Dictyosponge from the middle Devonian of the Eifel. This description is as follows: "It shows, like the former fossil (*Tetragonis* [*Prismodictya*] *Eifeliensis*, F. Roemer) a surface divided into rectangular areas, but the subdivision is less regular and more simple. The vertical rods are much stronger than the horizontal rods and, inasmuch as new ones appear toward the aperture, are not quite straight. Moreover the transverse rods do not always make right angles with the vertical rods, but are, especially over the lower part, directed obliquely against them. * * * farther subdivision of the rectangular areas by finer spicules is wanting."

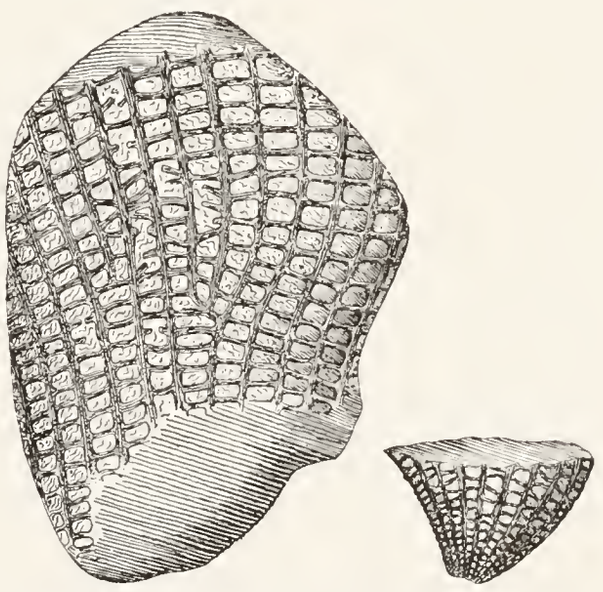


Figure 12. *Roemerispongia Gerolsteinensis.* (After F. Roemer). The convexity of the quadrules is not well shown in these copies.

The two wood-cuts of this fossil given by ROEMER and reproduced here, show very clearly the structure described. The original cuts also indicate distinctly an important character which the author does not mention, namely, the convexity of each of the non-reticulate rectangular areas, which we presume to be of a similar character to the surface nodes in PHYSOSPONGIA. The relation of the fossil to the latter genus is also seen in the relatively great size and mode of reticulation of the spicular bundles, while a generic difference in the two is found in the single vertical rows of quadrules, their increase by intercalation and in the convexity of all the quadrules in ROEMERISPONGIA, even in those of irregular shape over the early portion of the cup.

Geological horizon. From the Calceola-shales, Gerolstein (middle Devonian).

Professor CLEMENS SCHLÜTER has described under the name *Protospongia rhenana*, a Dictyosponge from the Hunsrück slates (lower Devonian), of Gemünden, Germany.* The original specimen is a mere fragment of a very coarse-meshed sponge whose generic characters are entirely uncertain.

SPECIES OF THE PORTAGE GROUP.

DICTYOSPONGIA, gen. nov.

(For description see page 72.)

DICTYOSPONGIA HAPLEA, sp. nov.

PLATE XXXIII, FIG. 1.

A small species of this genus is indicated by two specimens showing a smooth, regularly expanding, subcylindrical cup with a very fine reticulum. One of these specimens exhibits only the apical portion; the other represents nearly the entire length of the cup, has a diameter rather more than one-third of the length and is slightly contracted about the aperture. No trace of prismatic faces is preserved. This entire specimen measures 40 mm. in length, 14 mm. in greatest width and 11 mm. in width at the aperture.

Locality. In the sandstones of the Portage group; second falls of the Tannery gully, Naples, N. Y. (Collected by D. D. LUTHER.)

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*Zeitschr. der Deutsch. Geolog. Gesellsch. vol. 44, p. 615, 1892.

PRISMODICTYA, gen. nov.

(For description see page 79.)

Prismodictya palæa, sp. nov.

Plate xxxiii, Fig. 2.

The original specimen of this species indicates a small, elongate cup, expanding rather rapidly and attaining full width at about one-third of its length from the base. Its median width is about one-fourth of its entire length and its aperture is somewhat contracted.

The surface shows that the prism-faces are distinctly developed and these are crossed by two or three low horizontal ridges making vertically elongate rectangles with the prism-angles and at their intersections are low, very small nodes.

Reticulum very fine.

The single example observed has a length of 50 mm., a median width of 14 mm. and an apertural width of 10 mm.

Locality. In the Portage sandstones; second falls of the Tannery gully, Naples, N. Y. (Collected by D. D. Luther.)

HYDNOCERAS, Conrad.

(For description see page 95.)

Hydnoceras legatum, sp. nov.

Plate xxxiii, Figs. 5, 6.

Recent explorations have shown the presence in the Portage beds of a species which appears to be closely allied to typical forms of *H. tuberosum*, Conrad, of the Chemung sandstones. None of the material thus far collected, though from two localities, is of good quality, but enough is retained by the fragments gathered to show the presence of from four to six transverse rows of nodes which, over the lower portion of the sponge, are moderately strong and are separated by deep constrictions which bear little, if any, evidence of prismatic division. A fragment of a large individual has these nodes large, robust and blunt, similar to those in the gigantic form, *H. Avoca*, of the Chemung. (See Plate xi).

The *reticulum* is finely divided, rather more so than is usual in *H. tuberosum*. Probably additional differentiating features will appear when this Portage fossil becomes better known. For the present it seems wise to recognize the fossil by a distinct appellation, its specific value being tentative.

Dimensions. One of the specimens, somewhat distorted, has a length of 100 mm. The fragment of a large cup indicates an apertural width of 150 mm. and its original length was probably not less than 250 mm.

Localities. The first specimen found was taken from the Portage sandstone at the second falls of the Tannery gully, Naples; subsequently, the species was obtained at Varysburg, Wyoming county, in the ravine entering the village from the west. The latter horizon is considerably lower in the rock series than the former. (Collected by D. D. LUTHER.)

HYDNOCERAS EUTHELES (?).

PLATE XXXIII, FIG. 7.

(See page 105 and Plate viii, Figs. 5, 6.)

This species, characterized by its short form and long, pendant nodes, is described among the Chemung forms obtained at Cotton hill, near Avoca. A specimen from the Portage beds found in association with the preceding species, has an aspect so similar to *H. eutheles*, as to make probable the specific identity of the two. It is, therefore, for the present referred to that form. (Collected by D. D. LUTHER.)

HYDNOCERAS GRACILE, sp. nov.

PLATE XXXIII, FIGS. 3, 4.

SPONGE short, rapidly expanding, with three rows of nodes exposed, possibly a fourth near the base which is fractured. In two of these horizontal rows the number of nodes is normal, eight; but in the outer or apertural row some of the nodes are absent or but faintly developed. The apertural margin is retained in its entirety and while the absence of some of the nodes near this edge is noticeable and in accordance with the structure observed in other species, yet the nodes of this outer row are close to the margin, and not separated from it by any considerable area. The nodes of the upper row are low but those of the lower rows long and slender.

The *reticulum* is very fine, the primary subdivision being largely obscured and evidence of prismatic faces wanting. The two specimens which represent this species are similarly preserved, having been buried in the sediment without lateral compression. In their dimensions and individual characters they are very similar, though one is more favorably preserved than the other. Each has an apertural diameter of 50 mm., and their height is about 30 mm. Both of these dimensions have been somewhat modified by the slight compression

to which they have been subjected, probably the former slightly increased and the latter as much diminished.

Locality. In the flags below the Portage sandstones in the east-side ravine at Varysburg, Wyoming county. (Collected by D. D. Luther.)

CLEPSYDROSPONGIA, gen. nov.

Sponge subcylindrical; subequally expanded at both base and aperture, contracted medially. Apertural margin simple, not explanate. Mode of attachment at the base not known (possibly by a transverse disk or diaphragm as in Thysanodictya and Phragmodictya). Surface with transverse rows of low, pointed nodes, as in Hydnoceras.

Type, *Clepsydrospongia matutina*, sp. nov.

Clepsydrospongia matutina, sp. nov.

Plate xxxiv, Figs. 1, 2.

Sponge of moderately large size; originally subcylindrical. Diameter of basal and apertural extremities subequal; constricted medially so that the median width is about two-thirds of that at the ends. Both basal and apertural extremities appear to end abruptly, the latter showing a regular and but slightly expanded margin. The basal edge is not defined with precision but to all appearances it terminates simply as in the case of the aperture, although a transverse basal disk may have existed.

The surface shows evidence of five horizontal rows of nodes of the same character as those of Hydnoceras. The lowest of these is highly obscure; the second is somewhat more pronounced, as shown along the edges of the specimen. These lower rows are separated by a furrow so shallow that the surface in this region was virtually cylindrical. The third or median row of nodes is the most conspicuous of all. It is separated from adjacent rows by broad and moderately deep constrictions. The nodes also, are more strongly developed than elsewhere on the surface, are elongate and rather low. Both in this row and that following above, there are ten nodes, varying among themselves in size; those of the fourth row are not as strongly pronounced as those in the median row. The nodes of the fifth or apertural row are hardly discernible, and thus the apertural one-third of the cup and the basal one-third have a very similar aspect. These nodes are all conical and tufted.

Reticulum. The net work is very fine and sharp. The obscuration of the fundamental prism-faces makes the prevailing meshes of small size, about 1.5 mm. on each side, and though these may be again divided, combinations of them into larger quadrules are not emphasized. Thus the reticulation appears very uniform throughout.

Dimensions. The single specimen which has been observed of this species, has a length of 170 mm. Its width at the base is 65 mm.; at the aperture 75 mm.; on the median row of nodes, 60 mm.; across the median constrictions, 42 mm.

Locality. In the sandstone of the Portage group; second falls of the Tannery gully, Naples, N. Y. (Collected by D. D. LUTHER.)

SPECIES OF THE CHEMUNG GROUP.

DICTYOSPONGIA, gen. nov.

1855. *Tetragonis*, McCoy. British Palaeozoic Fossils, p. 62.

1880. *Tetragonis*, F. Roemer. Lethæa Geognostica, 1 Theil, p. 304.
Not *Tetragonis*, Eichwald, 1842. Urwelt Russlands, Heft 2, p. 81.

1883. *Dictyophyton*, Barrois. Sur les Dictyospongidæ des Psammites du Condroz, p. 85.

1890. *Dictyophyton*, Hall. Ninth Ann. Rept. N. Y. State Geol., p. 56.

Very gradually expanding, smooth, obconical or subcylindrical sponges with the outer surface devoid of nodes, tufts, ridges, annulations or other ornamentation; prism-faces sometimes very obscurely developed toward the summit; base furnished with a tuft of long, straight anchoring spicules.

Type, *Dictyophyton sceptrum*, Hall.

The fossil described by McCOY, (*op. cit.*) as *Tetragonis Danbyi*,* from the upper Ludlow rocks of Westmoreland, appears, from the description and figure given by the author and subsequently by Dr. HINDE, to be a reticulate sponge of this genus. In regard to the nature of the original species of EICHWALD's genus TETRAGONIS (*T. Murchisoni*, Eichwald), we may accept the opinion of HINDE, who says: "From an examination of undoubted forms of TETRAGONIS from the Silurian of Gotland, I believe that it is a sponge, and that it is very closely allied to ISCHADITES, Murch."

* *Dictyospongia Danbyi;* see page 63 of this volume.

Dictyospongia sceptrum, Hall (sp.).

Plate xiv, Figs. 3–6; Plate xv, Figs. 8, 9; Plate xvi, Figs. 3, 4; Plate xxvii, Fig. 3; Plate xxxvi, Fig. 7.

1890. *Dictyophyton sceptrum*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 56; and Forty-third Ann. Rept. N. Y. State Museum of Natural History, p. 258.

Sponge elongate, conical or subcylindrical; circular or elliptical in transverse section. Usually abnormally compressed, sometimes curved. Very gradually expanding from the base upward for one-half to two thirds its length, narrowing more abruptly toward the aperture.

Surface smooth or without prism-faces or any irregularities except those arising from distortion in fossilization.

Reticulum characterized by coarse, subequidistant transverse spicular bands, from 10 to 15 mm. apart, crossed by vertical bands of subequal size not more than one-half of this distance from each other. The impressions left by the vertical bands are not as deep and conspicuous as those of the horizontal, hence the first effect produced by the appearance of the specimens is that of a strong transverse lineation, and a secondary and very characteristic impression that of a division of the surface into vertical, elongate rectangles. Some of the specimens which have been enveloped in a soft clay-shale, retain the spicular bands themselves, changed through pyritization and oxidation into limonite, a very unusual occurrence in species from the Chemung sandstones. This preservation is insufficient to demonstrate the character of the individual spicules, though it shows the very fine reticulation of the primary quadrules.

Dimensions. The specimens at hand show considerable variation in form and size. The most robust of these, in which the aperture is retained while a small part of the basal portion is lost, has a length of 200 mm., a width at the base of 40 mm., greatest width at two-thirds its length from the base, of 70 mm. and a width at the aperture of 50 mm. This specimen has unquestionably been much flattened, which accounts for its great proportional width. A more slender cup, nearly complete from base to aperture and but slightly compressed, measures 252 mm. in length and 38 mm. in greatest width. In one example the cup is greatly curved, but instances of this kind seem to be due to the easy distortion of such long and slender bodies.

Localities. In the shaly sandstones of the upper part of the Chemung group at Alfred, Scio, Friendship, Nile, Andover, Cuba and Wellsville, Allegany county; Olean, Cattaraugus county, and Jamestown, Chautauqua county, N. Y.

This species is of very frequent occurrence in the upper beds of this formation, to which it appears to be restricted. Most of the specimens found have been obtained from isolated loose blocks, though Mr. E. B. HALL, of Wellsville, has located a considerable colony of them near that village. The species is well characterized and always readily recognizable by the vertically elongated quadrules of the reticulum.

DICTYOSPONGIA LOPHURA, sp. nov.

PLATE XV, FIG. 5.

SPONGE small, slender, long, circular in cross-section; gradually expanding for one-third of its length, thence upward nearly cylindrical. Surface smooth.

Reticulum composed of fine spicular bands, apparently divisible into but two clearly defined series. The transverse bands are the more conspicuous, and their division into primary and secondary series is clearly evident, but among the vertical bands this difference is more obscure. The general aspect of the surface is that of series of vertical parallelograms whose upper and lower boundaries are the primary horizontal bands. A subordinate reticulation is visible within the larger quadrules.

The single example observed of this graceful species has a length of 88 mm. to the base of the cup. So far it is an internal cast, but beyond this point is an external cast of a spreading brush of anchoring spicules or basalia, which may be traced for a distance of 33 mm., giving the specimen, which is essentially entire, a total length of 121 mm. The width of the cup at its upper end is 7 mm. and about the same at the middle of its length.

Locality. In the upper beds of the Chemung group. Found loose at Wellsville, N. Y. (Collection of E. B. HALL.)

DICTYOSPONGIA CHARITA, sp. nov.

PLATE XV, FIG. 4.

SPONGE very small, elongate, slender and graceful; expanding rather rapidly from the base for about one-half its length, slightly contracting toward or near the aperture. Transverse section circular or elliptical. Surface smooth.

Reticulum fine, with a predominance of the horizontal bands which, with the vertical lines, produce a division of the surface into rectangular quadrules about 3 mm. in length and 2.5 mm. in width; these are subdivided into approximate squares by two subordinate horizonal bands and one vertical

band. At the apex of the best preserved specimen is the impression of a short basal tuft of spicules.

Dimensions. One example measures in length, exclusive of the basal tuft, 36 mm.; its median diameter is 4.5 mm. and its apertural diameter, 3 mm. In a second specimen two individuals lie side by side, one of them measuring 37 mm. in length, with a median diameter of 7 mm. and an apertural diameter of 4 mm. This specimen has been somewhat flattened.

Locality. In the sandstones of the upper portion of the Chemung group at Wellsville, N. Y. (Collection of E. B. Hall.)

Dictyospongia eumorpha, sp. nov.

Plate xv, Figs. 1-3.

Sponge small, slender, elongate-subfusiform, expanding for about one-fourth its length from the apex, thence upward with parallel sides, contracting somewhat toward the aperture. Surface smooth; reticulation very fine, composed of minute subequal rectangular meshes, whose ordinal arrangement is not clearly defined.

Two specimens of this species upon the same slab of sandstone, measure 80 and 84 mm. in length, each having a maximum width of 15 mm. In the smaller individual the aperture is retained, but in neither is the basal extremity entire. The species is distinguished from the other forms here described by its more rapidly expanding and broader cup.

Locality. In the upper beds of the Chemung group at Wellsville, N. Y. (Collection of E. B. Hall.)

Dictyospongia siræa, sp. nov.

Plate xlii, Figs. 4, 5.

Sponge rather small, expanding gradually, but with greater rapidity on one side than on the other, thus giving the cup a semi-crescentic outline, a feature persistent in all specimens. The shape is thus long and slender, the aperture being somewhat narrower than the parts immediately below it. The lower portion terminates in a long, narrow rope of anchoring rods whose length is nearly if not fully as great as the body of the sponge.

The *reticulum* is composed of a net-work of small quadrules of generally uniform size, not often distinctly retained. The surface shows no nodes or other irregularities.

Dimensions. A specimen entire except for a part of the anchoring rope, measures in length, from base to aperture, 72 mm., the width of the aperture

being 17 mm., and the greatest width of the cup 22 mm. Another specimen with a length of 80 mm. and not quite entire at the aperture, has an anchoring rope of 50 mm. in length and this is incomplete at its lower extremity. The persistent curvature of this species and its relatively rapid expansion, together with its remarkably long basal tuft, will serve as distinguishing characters.

Locality. Several specimens have been found in the lower beds of the Chemung group at Cotton hill, one mile north of Avoca, Steuben county, in association with *Hydnoceras tuberosum*, *H. eutheles*, *H. multinodosum*, *Arystidictya elegans*, *A. nodifera* and *Hallodictya Cottoniana*.

DICTYOSPONGIA ALMONDENSIS, sp. nov.

PLATE XLIV, FIG. 1.

The grey sandstone beds at Almond, Allegany county, are, in places, crowded with fragments of a species of very large size, but for the most part these fail to afford a definite conception of the aspect of the entire sponge. Some of these large expansions like that illustrated on Plate xliv, show under compression an obscure prismatic surface, but usually the surface is smooth and the general appearance of the accumulated fragments indicates that they belong to a single species of DICTYOSPONGIA. Among the large number of specimens collected from this locality no single one clearly shows all the specific characters. The large example given presents the maximum size observed while the accompanying figure represents the basal portion of a specimen, showing its rapid expansion and curving sides, retaining, as well, the elongate parallelograms of the reticulum which are more or less noticable in other species of DICTYOSPONGIA.

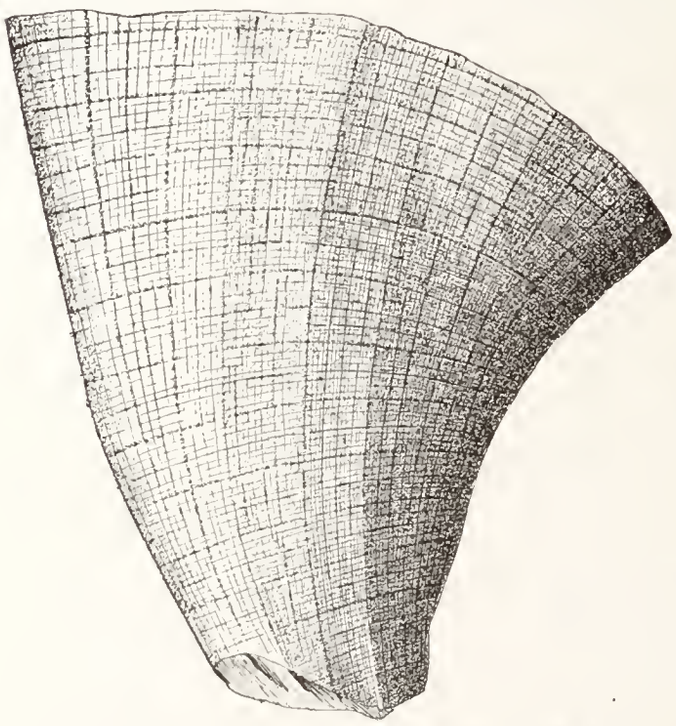


FIGURE 13. The basal portion of *Dictyospongia Almondensis*.

This is our largest species of the genus, and doubtless its great size is in itself the principal occasion of so delicate a structure being retained only in this highly fragmentary state.

Locality. Almond, N. Y. (Collection of E. B. Hall.)

Dictyospongia (?) bacteria, sp. nov.

Plate xxxviii, Figs. 7, 8.

This is a slender, nearly cylindrical sponge, which, in the entire length, shows but slight indication of tapering in either direction. Originally its surface was doubtless smooth and this aspect is modified in the fossil only by some low casual corrugations and indentations. The substance of the skeleton was extremely thin as shown in transverse section and is represented by a tenuous ferruginous film. Under favorable light there is evident an extremely fine transverse lineation of the surface but vertical striation is extremely obscure. The fossil has a quite different aspect from the other species of Dictyospongia here described and while there is good reason to regard it as of this genus, it may prove to be of a somewhat different nature. Small patches of iron oxide on the surface of the specimen show actinic spots which, though failing to resolve under high magnification, suggest that these may be parenchymal or dermal spicules.

The length of the specimen illustrated is 110 mm. and is incomplete. Its width is 12 mm. at each extremity and 15 mm. in the middle.

Locality. From a calcareous sandstone in the upper Chemung formation, associated with numerous brachiopods: *Spirifer disjunctus*, *Orthothetes Chemungensis*, *Strophcodonta demissa* var., *Productella lachrymosa*. The precise locality of the specimen is not known, but it is probably from Steuben county.

HYDRIODICTYA, gen. nov.

1884. *Dictyophyton*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469.

Simple, broadly expanded, vase shaped cups without nodes, ridges or other conspicuous surface characters, and with no apertural spicular fringe.

Type, *Dictyophyton patulum*, Hall.

HYDRIODICTYA PATULA, Hall.

PLATE IV, FIG. 1.

1884. *Dictyophyton patulum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469.

SPONGE, of which the upper portion only is known, broadly funnel-shaped. Diameter of the aperture more than twice that at 60 mm. below the aperture. Surface marked by very faintly subprismatic and rapidly expanding faces.

Reticulum coarse-meshed, the primary quadrules being bounded by vertical spicular bands which traverse the edges and middle of the subprismatic faces and are intersected by horizontal bands of the same strength. These quadrules are trapezoidal on account of the expansion of the cup; an average example of them measures 11 mm. at the base, 15 mm. at the top and 17 mm. in height. These primary quadrules decrease greatly in size toward the aperture and are all distinctly subdivided by the impressions of three or four subordinate series of spicular bands.

The original specimen has a length of 63 mm.; an apertural diameter of 130 mm., and a diameter at the lower broken end, of 60 mm.

Locality. From the middle beds of the Chemung group, in the *Hydnoceras tuberosum* colony, at the Brown hill school-house, near Cohocton, Steuben county, N. Y.

HYDRIODICTYA CYLIX, sp. nov.

PLATE V, FIGS. 1, 2; PLATE XVI, FIG. 2; PLATE LV, Fig. 7.

SPONGE regularly conical, rather rapidly expanding; surface destitute of nodes or other ornamental characters. A small specimen bears a few irregular nodiform elevations which are, however, wholly due to the accidents of fossilization.

Reticulum regular, the prevailing meshes measuring from 2.5 to 3 mm. on each side, and being subdivided by one or two subordinate series of spicular bands. There is no grouping of these into well-defined quadrules of large size, and no evidence of the projection of the spicular bands into free lamellae.

The largest specimen observed shows a patch on its surface where the original skeleton had evidently been broken and was subsequently repaired by the formation of a highly irregular net, totally lacking the regular quadrulation of the adjoining parts of the cup.

Dimensions. A small, apparently entire individual has a length of 60 mm. and an apertural diameter of 50 mm. A larger example, which is nearly entire, is 110 mm. in length and of about the same width at the upper extremity.

Locality. In the lower beds of the Chemung group; from a shaly sandstone at Deyo basin, Naples, Ontario county, N. Y., in association with *Hydnoceras variabile*, *Ceratodictya annulata*, various brachiopods of the Chemung fauna and abundant remains of terrestrial plants.

Hydriodictya nephelia, sp. nov.

Plate xxi, Fig. 10.

This species is represented by the upper portion of a flattened cup, characterized by its broadly expanded and regular aperture and perfectly smooth surface. The median or lower part of the cup tapers much less rapidly than the apertural portion.

The *reticulum* is composed of extremely fine spicular bands, those of the horizontal series being rather the more clearly defined. They occur at intervals of about 4 mm. and form, with the divergent vertical lines, somewhat trapezoidal quadrules. These spaces become obsolete toward the aperture and the entire surface is minutely subdivided by the subordinate spicular bands.

The dimensions of the single example observed are as follows: length 108 mm.; width at the lower end 65 mm.; at the aperture 125 mm.

Locality. In the upper beds of the Chemung group at Wellsville, N. Y. (Collection of E. B. Hall.)

PRISMODICTYA, gen. nov.

1863. *Dictyophyton*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., pp. 88, 89.

1882. *Dictyophyton* (partim), Hall. Notes on the Family Dictyospongidæ.

1884. *Dictyophyton* (partim), Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 466, 469–471.

Elongate, usually slender sponges, with acute, gradually expanding base and sharply prismatic surface, the prism-faces numbering eight; aperture slightly contracted; surface without tufts or lamellar ridges; rarely with inconspicuous nodes on or between the interfacial angles.

Type, *Dictyophyton telum*, Hall.

PRISMODICTYA TELUM, Hall (sp.).

PLATE XVII, FIGS. 3–10; PLATE XXXV, FIGS. 7, 8; PLATE XLII, FIG. 2.

1884. *Dictyophyton telum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 470.

SPONGE small, sharply prismatic, octagonal in section; prism-faces flat or slightly concave. The base is broad but acute, all the prism-faces being well defined; the sponge expands rather rapidly attaining its greatest diameter at about one-third of its length, thence it contracts very gradually upward becoming narrowest at about one-fifth of its length from the upper end, again it expands slightly, and at the aperture the margin is somewhat abruptly narrowed.

Reticulum very fine, without prominent vertical bands upon the prism-faces, but showing, in a few instances, rather coarse horizontal bands. The prevailing large quadrule appears to be that which is bounded laterally by the prism-angles, and it therefore varies in width with the expansion of these faces. These major quadrules are, however, very largely obscured by the finer reticulation of the surface.

Dimensions. Entire examples of this species are not uncommon. The original specimen, which is an entire internal cast, has a length of 64 mm.; its greatest diameter is 20 mm. from the basal point and measures 18 mm.; the diameter just below the aperture is 11 mm., and the aperture itself is 7 mm. in major, and 5 mm. in minor diameter. A larger specimen is 87 mm. in length, 21 mm. in greatest diameter, and 15 mm. in diameter at the aperture.

This very neat and pretty species is distinguished by the peculiar cigar-shaped form of the cup and its persistently small size. It appears to be subject to but slight variation in these respects except such as may result from compression or other disturbances in fossilization. Occasionally an abnormal tendency to spiral growth is manifested, and one of the examples figured shows how completely this tendency may affect the entire cup. Such a result could hardly be the result of casual cause.

A block of sandstone from Wellsville is crowded with these sponges, and the exposed surfaces of nearly all the cups, especially of the larger individuals, bear numerous irregularly oblique ridges and furrows, which traverse the cup more or less completely in a spiral direction. In some instances their continuity may be traced more than once around the sponge. In one example these markings are ridges on the surface and grooves on the opposite side, the two being to a certain degree continuous; the difference in their character

is undoubtedly a matter of difference in retention. Over the surface of these markings, whether ridges or grooves, the meshes of the reticulum are distinctly seen. There is so close a resemblance in these features to tubes of annelids or those left by certain boring sponges as to justify the suggestion that we have here an indication of parasitism or commensalism of such boring or tubicolous animals with the Dictyosponges. On Plate ix (fig. 2) is given a figure of *Hydnoceras tuberosum* var. *glossema* which very distinctly shows similar vermiform markings.

Localities. In the upper beds of the Chemung group; the original specimens were derived from a locality now unknown, in Cattaraugus county. The species has been found in some abundance at Wellsville and Friendship, Allegany county, N. Y.

Prismodictya baculum, Hall (sp.).

Plate xviii, Figs. 1–3.

1884. *Dictyophyton baculum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 471.

Sponge prismatic, distinctly octagonal, the prism-faces being flat or very slightly concave; form very gradually expanding from the base for about one-half its length, thence enlarging rapidly and again contracting toward the aperture.

Reticulum. The primary quadrules measure about 7 mm. on the edge, but distinctly enlarge in size from below upward. Each quadrule is bounded vertically by the band upon the prism-angle and by one medially dividing the prism-face. The horizontal bands have left sharply defined impressions upon the surface of the cast. The character of the reticulation is, throughout, essentially the same as that of *Prismodictya Conradi*, but the species differs from the latter in its more gradual expansion from the base upward and the absence of the peculiar nodes of that species; it differs from *P. parallela* in its distal expansion and the absence of elevated horizontal ridges with nodiform intersections.

Dimensions. The length of the best preserved example is 60 mm.; this specimen is probably but slightly imperfect at the aperture, though somewhat more at the basal extremity. Its diameter at the lower end is 26 mm.; at the greatest width, 43 mm., and at the upper end, 39 mm.

Locality. In the Chemung group at Wellsville, Allegany county, N. Y.

PRISMODICTYA SPECTABILIS, sp. nov.

PLATE XX, FIG. 5.

SPONGE large, long, rather slender; octagonal cross-section well-defined. Prism-faces flat or, at times, slightly convex along the median line; diameter gradually increasing from the base to a point distant about one-fifth of the entire length of the cup; from this point upward the width does not vary except for an abrupt contraction at the aperture. For a short distance near the base the surface of the sponge is smooth and all evidence of the prismatic faces obscured; the latter, however, rapidly become defined and are well developed at about an inch from the basal extremity. The impression of the reticulum upon the original internal cast shows a strong development of the subordinate spicular bands, the coarser meshes being pretty generally obscured. There are traces of elevated horizontal bands at intervals of about 10 mm. and these make nearly square quadrules with the prism-angles, and subordinate squares or rectangles with the median line on each face. Toward the lower end of the sponge the vertical bands are more prominent than elsewhere.

Dimensions. The specimen which has served as the basis of this description consists of two fragments, one representing the basal and the other the upper part of the sponge, a portion of the median part being lost. Judging from the slope of the sides the original length of the sponge must have been about 275 mm. The full diameter, which is attained at 75 mm. from the base, is 37 mm. and this is maintained nearly to the aperture. The sponge shows a slight curvature, but this is probably casual.

Locality. In the upper beds of the Chemung group at Wellsville, Allegany county, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA PARALLELA, Hall (sp.).

PLATE XIX, FIG. 4; PLATE XX, FIG. 6; PLATE XXI, FIGS. 8, 9; PLATE XXXV, FIG. 9.

1884. *Dictyophyton parallelum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 471.

SPONGE prismatic, elongate, slender, very gradually enlarging; prism-faces slightly convex, divided by a median vertical ridge which is somewhat elevated. Surface crossed by elevated horizontal bands at intervals varying from 8 to 10 mm.; making low nodes at their intersection with the prism-angles. The subordinate division of the reticulum is normal.

This species is not completely understood. The original specimen, which is an external cast in sandstone measuring 130 mm. in length, has a diameter of 28 mm. and evinces little, if any evidence of expansion in the cup. This, of itself, is the character which will best serve to distinguish the form from related species. The horizontal reticulation of the cup is strong, but it is probable that its relative prominence is due wholly to mode of preservation. A second specimen referable to the species retains a portion of the sponge without compression and in this the prominence of the median vertical band on each prism-face obscures the sharpness of the primary octagonal form of the cross-section, duplicating in some degree the number of prism-faces.

A third specimen, though incomplete at both extremities, has a length of 200 mm. showing that the species attained considerable length without notable variation in caliber.

Localities. The original specimen is from the Chemung group of western New York, its precise locality being unknown. Other examples of the species have been found in the upper sandstones at Wellsville, Allegany county, and at Olean and Hinsdale, Cattaraugus county, N. Y., by Mr. E. B. Hall.

Prismodictya prismatica, Hall (sp.).

Plate xvii, Fig. 1; Plate xxi, Figs. 1–6; Plate xlii, Fig. 6.

1882. *Dictyophyton filitextile*, Hall. Notes on the Family Dictyospongidæ pl. 17, figs. 2, 2a.

(Not *D. filitextile*, Hall, 1863 and 1884.)

1884. *Dictyophyton prismaticum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469, pl. (17) 18, fig. 2.

1889. *Dictyophyton prismaticum*, Lesley. Dictionary of Fossils, p. 200.

Sponge regularly enlarging from base to aperture, without rapid increase in diameter at any part; somewhat variable in shape, often without perceptible expansion for a considerable portion of the cup, and with a slightly contracted aperture, but usually expanding to an aperture whose diameter is the greatest width of the sponge; sometimes curved and, not infrequently, somewhat twisted; prism-faces flat.

Reticulum as in the allied species here described, there being a median spicular band on each prism-face, with two or more accessory bands which may be more or less distinctly retained. The expression of the surface varies with the condition of preservation of the individual specimens, sometimes the

major quadrules predominating, at others these being obscured by the lesser meshes. At the intersections of the prism-angles with the horizontal spicular bands, the internal casts show small pits which probably indicate the presence at those points of spicular tufts. All the principal bands, and perhaps, also the subsidiary bands, were extended laterally from the body of the cup into narrow, erect lamellae, from .5 to 1 mm. in width.

Dimensions. An average specimen which is nearly entire has a length of 90 mm.; its diameter at the base is 8 mm. and at the top 27 mm. Incomplete specimens of larger individuals having similar dimensions abound. In one specimen there is no increase in diameter in a length of 80 mm., examples of this character being of somewhat less frequent occurrence than the others.

This sponge is not widely different from those described as *Prismodictya parallela*, and when both are better known it may prove that the more regularly prismatic forms here described are identical with that species, but at present there seems no sufficient ground for separating the various forms of *P. prismatica*, all of which occur in association.

Localities. In the upper beds of the Chemung group; in great numbers in a light grey sandstone at Concord, Erie county, Pennsylvania; also at Wellsville, Allegany county, Olean, Cattaraugus county, N. Y., and at Warren, Pennsylvania.

PRISMODICTYA ALLEGANIA, sp. nov.

PLATE XX, FIG. 4.

SPONGE large, octagonal in cross-section, prism-faces clearly but not sharply defined; each divided by a more or less prominent median vertical ridge and rendered thereby somewhat convex. Basal portion rounded, the prismatic surface being undefined for about one-fifth of the length of the sponge. The expansion of the cup is gradual for nearly two-thirds of its length where the greatest diameter is attained; the upper part is considerably expanded and again contracted towards and about the aperture.

Reticulum. The prevalent major quadrules are formed by the intersection of low horizontal bands with those on the prism-angles and on the middle of the prism-faces. These average about 9 mm. across the base and 11 mm. in height. The subordinate reticulation is, as a rule, quite clearly retained to the fifth or sixth degree.

Dimensions. The largest specimen observed, which is incomplete at the basal extremity and for a short distance near the aperture, is 210 mm. in length, 53 mm. wide at the lower end and 75 mm. in diameter at the greatest

expansion, which is 70 mm. from the upper end. A somewhat smaller but more complete example has a length of 185 mm.; an apical diameter of 15 mm.; a greatest width of 60 mm. and a subapertural diameter of 50 mm.

This species bears some similarity to *Prismodictya baculum* in the expansion of the cup above the middle, but differs in its proportionally less slender form and its persistently greater size. A number of specimens from different localities all show the specific characters described.

Localities. In the upper beds of the Chemung group, at Scio and Almond, Allegany county, and Ischua and Olean, Cattaraugus county, N. Y. (Collection of E. B. Hall.)

Prismodictya choanea, sp. nov.

Plate xix, Figs. 1-3; Plate xxvii, Fig. 5; Plate xxxv, Fig. 6.

Sponge large, elongate, rapidly expanding from the base, attaining a greatest diameter above the middle, thence somewhat abruptly contracting to the aperture. Median transverse section rounded octagonal. Surface smooth about the base, thence upward becoming faintly prismatic, these prism-faces again becoming obscure and finally obsolete toward the summit.

Reticulum fine; composed of quadrules the largest of which, over the basal portions of the cup, are bounded vertically by the edges of the prism-faces, crossed by horizontal bands at subequal distances. This makes of the main quadrules, squares measuring about 30 mm. on each side. These large areas are distinctly subdivided by one inferior series of bands, and each of these, in its ultimate division, contains approximately 256 meshes.

Toward the median portion of the sponge the prismatic faces become somewhat more obscure and the division into the quadrules of the first and second order more sharp.

Dimensions. This description is based upon specimens which represent only the lower portion of the sponge and we are not justified in inferring the character of the upper part except that while the species may assume the proportions of *Prismodictya corynia* in its later growth, it probably does not become so strongly prismatic as does that species. On the other hand, it is easy, from the obscurity of their prism-faces, to confound such specimens as those figured, with the *Dictyospongia Almondensis*, the fragments of which, occuring in great numbers in the grey sandstone at Almond, sometimes show faint prismatic divisions which are wholly the result of compression.

Localities. In the upper beds of the Chemung group at Ischua and Olean, Cattaraugus county, N. Y. (Collection of E. B. Hall.)

PRISMODICTYA CORYNIA, sp. nov.

PLATE XVII, FIG. 11.

SPONGE large, the incomplete specimen on which the species is founded indicating a greater size than is attained by any other known representative of the genus; expanding with some rapidity from the base and contracting toward the aperture. Prism-faces clearly defined, some of them with a low elevation in the median line, their edges scarcely elevated into ridges. Surface reticulated by spicular bands of subequal size, which, by intersection, form quadrules about 6 mm. square; a size which is uniformly maintained over the entire surface, except for a slight diminution toward the base and summit. This is the quadrule which impresses one as being the most prominent, though a combination of sixteen of these, four on each side, covers one-half the width of each prism-face. The quadrules are subdivided by three sets of spicular bands.

This sponge attained a size equal to that of *P. choanea*, but is readily distinguished from that species by its more sharply prismatic surface. *Prismodictya choanea* is very obscurely prismatic and in this respect approximates the normal condition of DICTYOSPONGIA.

Dimensions. Length of the specimen described, 140 mm.; probable original length not less than 240 mm.; diameter at the lower end 90 mm.; at the middle 110 mm.; at the top 90 mm.

Locality. In the upper beds of the Chemung group, Alma, Allegany county, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA FILITEXTILIS, Hall (sp.).

PLATE XXI, FIG. 7; PLATE XXVII, FIG. 4.

1873. *Dictyophyton filitextile*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 88, pl. iv, fig. 5.

1884. *Dictyophyton filitextile*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 470.

SPONGE small, slender, very gradually enlarging. Surface obscurely prismatic, the prism-faces being convex.

Reticulum extremely fine; a very sharp external cast shows that the major quadrules are formed by the intersection of horizontal bands with the prism-angles, slight nodes being made at these points. These quadrules measure about 8 by 9 mm., being somewhat higher than wide. The subordinate reticulation, however, usually obscures the larger meshes.

Dimensions. The original specimen has a length of 60 mm., a width at the lower end of 11 mm., and at the upper end of 15 mm. Essentially the same proportions are exhibited by other specimens. The species is distinguished by the obsolescence of the prism-faces, its fine reticulation and usually small size.

Localities. In the upper beds of the Chemung group. The original specimen is from some locality, now unknown, in Steuben county; others have been found at Wellsville, Allegany county, N. Y., by Mr. E. B. Hall.

Prismodictya banano, sp. nov.

Plate xvii, Fig. 2.

Sponge elongate and quite slender; regularly expanding for nearly one-half its length, thence very gradually decreasing in width to the aperture; distinctly prismatic; prism-faces slightly concave.

Reticulum fine, the principal quadrules apparently being bounded by the prism-angles and subequidistant horizontal bands.

Dimensions. The original specimen, which is complete at the aperture but slightly broken at the basal extremity, has a length of 120 mm. with a probable original length of 135 mm. The diameter at the lower end is 11 mm.; just below the middle, 20 mm., and at the aperture 13 mm.

This species is much more slender than any other of the forms of Prismodictya except *P. amicitiæ*, and as the latter is quite distinct in size and contour, the form will be readily distinguished.

Locality. In the upper part of the Chemung group at Scio, Allegany county, N. Y. (Collection of E. B. Hall.)

Prismodictya amicitiæ, sp. nov.

Plate xxxvi, Figs. 2–4.

Sponge small, slender, graceful, and cigar-shaped, being somewhat broadest toward the lower end just above the basal point, thence upward tapering very gradually and regularly to the aperture. In respect to this expansion of the lower part, the species resembles *P. telum*, but is a much more slender sponge than that.

The prism-faces are not very sharply defined, so that without the actual obliteration of the interfacial angles, these are rendered obscure by a general convexity of the surface, which characterizes the entire length of the sponge.

Reticulum as in other forms of this genus.

This species will be readily recognized by its persistently slender and graceful form and subprismatic surface. Among the examples figured one is given which again shows that a spiral mode of growth, such as that already shown to occur in specimens of *P. telum*, occasionally manifests itself here.

Dimensions. The best preserved specimen has a length of 90 mm. Its greatest width, one-third of its length from the base, is 13 mm.; at the aperture the width is 9 mm.

Locality. Several specimens of this form have been found in the upper sandstones of the Chemung group at Friendship, Allegany county. (Collection of E. B. HALL.)

PRISMODICTYA AULOPHIA, sp. nov.

PLATE XX, FIGS. 7, 8; PLATE XXXIV, FIGS. 4, 5; PLATE XLI, FIG. 7.

SPONGE of moderate size, gradually expanding to its full width at about two-thirds of its length, again contracting towards the aperture. Surface with deeply concave prism-faces and elevated prism-angles. Each prism-face is divided medially by a vertical spicular band, which is clearly defined on all specimens. These and the longitudinal bands upon the prism-angles, bound opposite sides of major quadrules about 6 mm. square, the reticulum over each of these areas being extremely fine. A small specimen which appears to be complete, is 50 mm. in length and 27 mm. in diameter across the upper extremity. A fragment of a larger cup measures 85 mm. in length, and the entire length, judging from the inclination of the sides, was upward of 100 mm. The concave, fluted surface of this sponge renders it unlike any other here described.

Localities. This species has been found in numbers in some blocks of compact and fine-grained red sandstone, belonging to the upper beds of the Chemung group, at Wellsville; less abundantly in greenish and more argillaceous layers at the same locality, and, also, in some abundance in a greenish siliceous sandstone at Scio, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA PTIONIA, sp. nov.

PLATE XXXIV, FIG. 3.

This sponge is of rather large size and of somewhat similar aspect to the smaller species, *P. cithara* and *P. cercidea*, the cup expanding rapidly from a narrow, doubtless somewhat extended stalk into a broad and inflated body whose prism-faces are gently concave. At, or just above, the greatest width of the sponge, low nodes are formed on the prism-angles, as in the

species cited, but are much less conspicuous than in those. Though the specimen described is incomplete, it is evident that the sponge rapidly narrowed from the line of these nodes upward.

The *reticulum* is as in other prismatic species. Along the middle of each prism-face is a conspicuous spicular band and the major quadrules which this forms with the prism-angles are clearly divided by four series of lines, all of them distinct without any one series obscuring the rest.

Dimensions. The single specimen of this form observed has a length, covering only the body of the cup, of 125 mm.; its width at the fractured base is 20 mm. and across the swollen body, 110 mm.

Locality. From the upper Chemung sandstone at Scio, N. Y. (Collection of E. B. Hall.)

Prismodictya cercidea, sp. nov.

Plate xx, Fig. 1–3; Plate xlii, Fig. 3.

Sponge small, fusiform, with well defined prism-faces which are flat or somewhat concave; rather gradually expanding for somewhat more than one-half its length, where its greatest diameter is attained, thence tapering with greater rapidity to the aperture which is contracted and very small. At the apex the eight prismatic faces are distinctly defined and, at the summit, these faces so nearly meet that in some instances it is impossible to determine which is the basal and which the apertural extremity. At the greatest expansion of the sponge, near the middle, there are thickenings or elongated nodes upon the prism-angles.

Reticulum fine; prism-faces devoid of prominent vertical spicular bands, while the horizontal bands are numerous but not conspicuous. The largest quadrule, measuring 4 mm. on each side, is frequently repeated, but the minor subdivisions of the net-work prevail on all the specimens observed.

Dimensions. Of three entire individuals one measures 62 mm., and two 55 mm. in length. All are somewhat compressed, but agree in having a greatest diameter of 22 mm. The apertural diameter is not more than 2 or 3 mm.

The presence of low nodes on this species shows its relationship to *P. ptionia* and *P. cithara*. To the latter *P. cercidea* is very closely allied but does not possess its long slender base.

Locality. In the upper part of the Chemung group at Wellsville, Allegany county, N. Y., associated with the lamellibranch, *Sphenotus contractus*. (Collected by E. B. Hall.)

PRISMODICTYA CITHARA, sp. nov.

PLATE XXXV, FIGS. 1–3; PLATE XXXVI, FIG. 5.

SPONGE of small size, with a very gently expanding, stalk-like basal portion which, at about mid-length of the sponge rather abruptly widens, very gradually tapering toward the contracted aperture.

The lower part of the sponge is more or less distinctly prismatic and the faces and angles are retained over the expanded portion. Where the greatest width of the cup is attained, low, elongate nodes are developed upon the prism-angles. These are of the same character as those already described for *P. cercidea* and *P. ptionia*, being very much elongated vertically and scarcely thickened. As in the species cited, also, they appear in but a single transverse row. By distortion, the nodes in one of the specimens figured are made to appear of exaggerated size; usually they are low and obscure.

The *reticulum* is fine, as in *P. cercidea*, and the chief difference in these species is in the extended basal portion of that under consideration.

Dimensions. A large, slightly distorted but nearly entire specimen is 73 mm. long, 7 mm. wide near the base, and 22 mm. wide where most expanded. This seems to be exceptionally large size and a considerable number of others indicate prevailing less size, a normal small specimen having a length of 39 mm., a width at the base of 4 mm. and a greatest diameter of 15 mm.

Locality. In a compact siliceous sandstone of the upper part of the Chemung group at Scio, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA NARTHECIA, sp. nov.

PLATE XXXV, FIGS. 4, 5.

This small species is allied to *P. cithara* and *P. cercidea;* more closely to the former, from which it differs in its more slender form, and though it is not without the median expansion of that species, yet this is very much less in degree and bears only the faintest suggestions of nodes. The slender base which it possesses in common with *P. cithara*, will distinguish it from *P. cercidea.*

But a single specimen of this little sponge has been observed. This measures 44 mm. in length, 3 mm. in width at the base, 9 mm. in width where broadest, and 5 mm. across the aperture.

Locality. In the upper beds of the Chemung group at Scio, N. Y., associated with the preceding species. (Collection of E. B. HALL.)

Prismodictya Conradi, Hall (sp.).

Plate xviii, Fig. 4; Plate xix, Figs. 5, 6.

1863. *Dictyophyton Conradi*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 89, pl. v, fig. 2, pl. v a, fig. 2.

1884. *Dictyophyton Conradi*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 471, pl. (17) 18, figs. 3, 4, 4a.

1882. *Dictyophyton Conradi*, Hall. Notes on the Family Dictyospongidæ, pl. 17, figs. 3, 4, 4a.

Sponge obconical, slightly arcuate toward the base; the original specimen is somewhat compressed laterally, sharply prismatic, the eight prism-faces being without evidence of median longitudinal ridges, with obscurely concave surfaces and broadly elevated margins. Toward the upper extremity are a few nodiform protuberances produced by the depression and elevation of the surfaces between the prism-angles. These nodes are low, evenly rounded and alternate in position on adjoining faces, presenting thus to some degree the aspect of the nodiform surface in the genus Physospongia. The specimen unfortunately terminates soon after the appearance of these nodes. The prism-angles are not modified by this configuration of the faces. On one side of the specimen, however, at something less than one-half its length from the apex, are two or three lower elevations in a transverse line on the prism-angles.

Reticulum. Each prism-angle bears the impression of a strong vertical strand of spicules, which is crossed at subequal intervals by similarly strong horizontal bands. This interval is about 5 mm. and is maintained from base to top without material increase or diminution. Where these intersect the primary bands, there are slight cavities or minute pits such as are more distinctly seen in specimens of *P. prismatica*, and which probably indicate the existence of small spicular tufts at these points of intersection. The absence of prominent vertical bands upon the surface of the prism-faces, gives to the primary division of the reticulum the aspect of a series of transverse and flat annular bands. Considering the primary quadrules to be about 5 mm. square, it is possible to trace on some parts of the specimen a division of the reticulum to the sixth degree.

Dimensions. The length of the original specimen is 130 mm.; its diameter at the apical end, 5 mm.; at one-half its length its major and minor diameters are 38 and 23 mm., while at the upper extremity these are 44 and 22 mm.

Locality. In the upper beds of the Chemung group, at Randolph, Cattaraugus county, N. Y.

GONGYLOSPONGIA, gen. nov.

Elongate, subprismatic sponges, with irregular protuberances or nodes developed on the prism-faces in single alternate or opposite vertical rows.

Type, *Gongylospongia Marshi*, sp. nov.

GONGYLOSPONGIA MARSHI, sp. nov.

SPONGE approaching PRISMODICTYA in general aspect, the prism-faces being clearly manifested throughout the length of the skeleton. The expansion from the base upward is gradual and is greatest at about two-thirds of the length from the point of attachment.

Near the base, protuberances appear on each prism-face in a vertical row. These protuberances are at first low and irregular lumps, separated from each other by more or less longitudinal depressions. With increase in the size of the sponge, the protuberances become more prominent and may show several points or apices, while the separating depressions are much deeper. When at full size the surface of the protuberances may carry several small and irregular concavities.

On adjacent prism-faces these nodes seem to correspond for the most part in position, but there are noticeable exceptions in which a depression in one row lies against a node of another. Moreover there is a frequent difference in the size and number of these projections in the various rows. Irregularity in all traits is their leading characteristic.

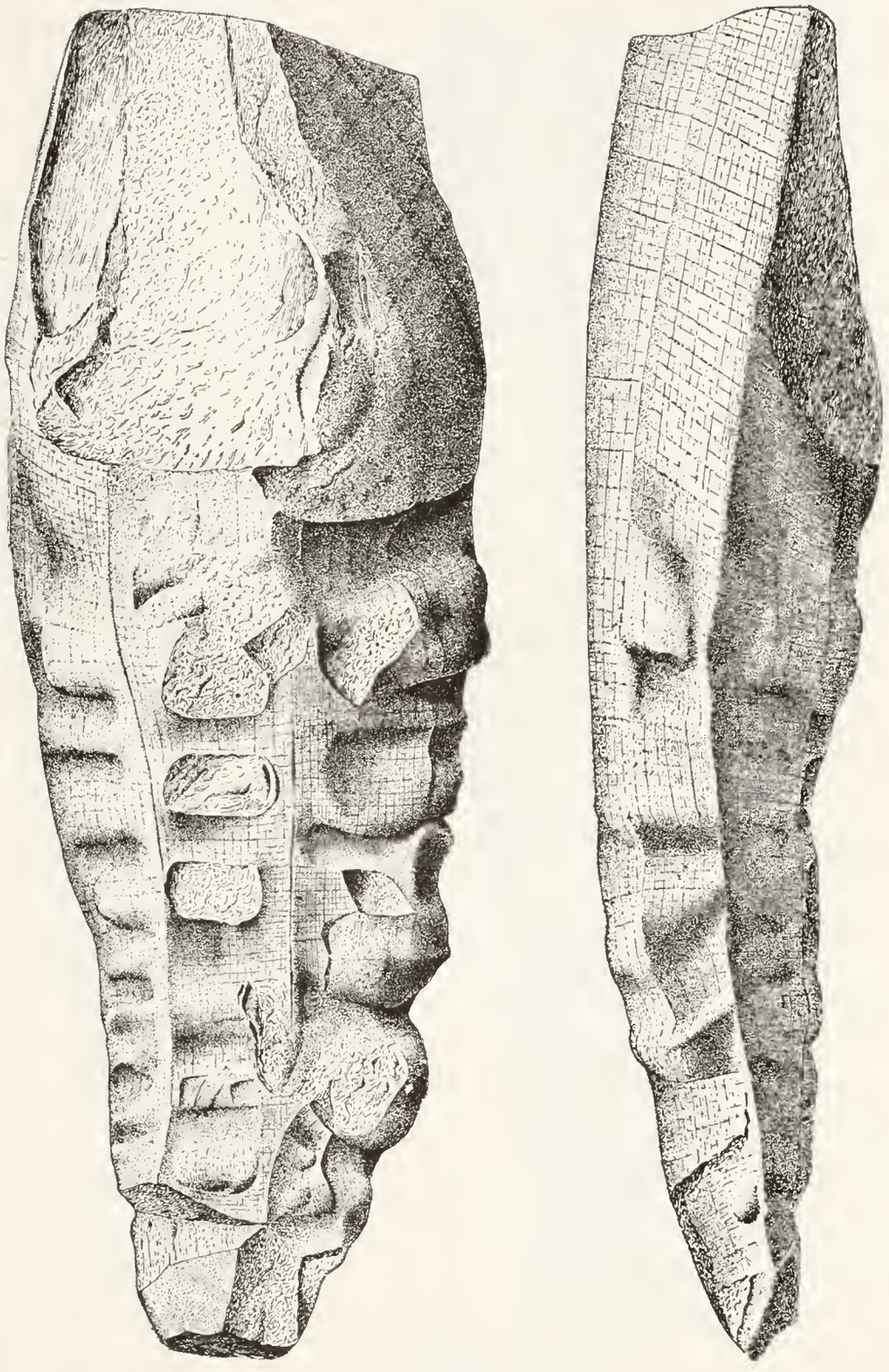
The prism-angles are pretty sharply developed between these rows of nodes and on some of the faces the vertical angles of the second order are seen to traverse the nodes.

After the maturity and full size of the sponge has been attained, the node-like irregularities rapidly disappear and all the later portion of the sponge is free of them. Over the apertural region, hence, the prismatic and primitive form of the sponge is strikingly manifested.

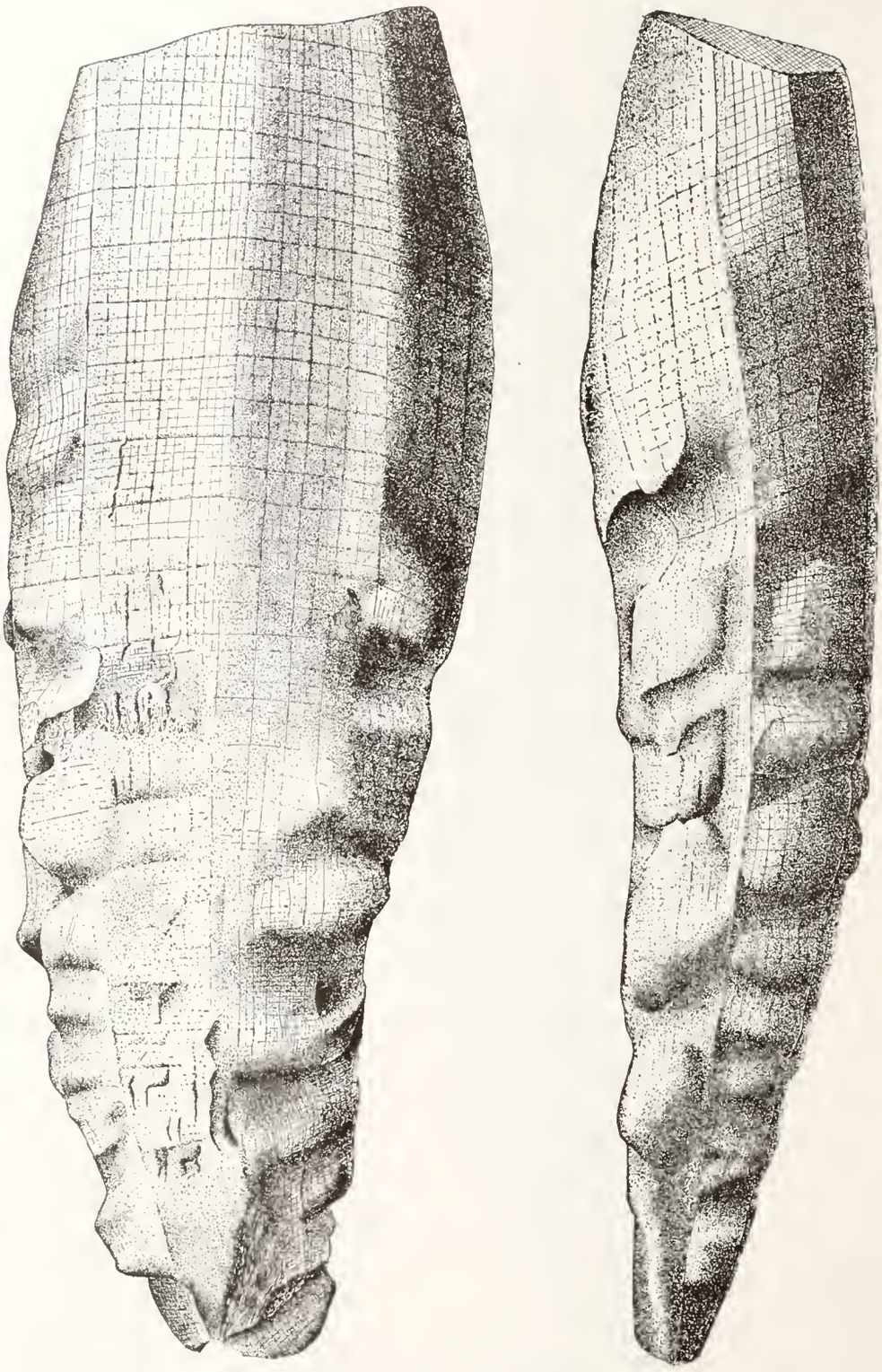
Reticulum as in PRISMODICTYA.

Dimensions. The single specimen found of this interesting species is represented in the accompanying illustrations. Its length is 190 mm.; greatest width (under some compression) 70 mm., and apertural width 55 mm.

Locality. In the Chemung beds at Wellsville, N. Y. (Collection of E. B. HALL.) Named for Professor O. C. MARSH, of New Haven, Conn.



FIGURES 14, 15. *Gongylospongia Marshi.*



FIGURES 16, 17. *Gongylospongia Marshi.*

Observations. The tendency among Dictyosponges of prismatic foundation to produce nodes upon the surface, manifests itself in two ways; these nodes develop either along the prism-angles, as in Hydnoceras and Botryodictya, or on the prism-faces, as in *Prismodictya Conradi*, Gongylospongia and Tylodictya. In the last named genus, however, the prismatic foundation is almost completely suppressed, although the nodes show very much the same irregular characters as in *Gongyl. Marshi.*

The characters of *Prismodictya Conradi* have already been pointed out. The single specimen known of the species shows, near the fractured upper end, an obscure nodation on several of the sharp prism faces. These are gentle and regular convexities and concavities lying in alternating rows. How irregular they may have become in later growth it is, of course, impossible to say, but the most primitive form of the node in *Gongyl. Marshi* is of more complicated shape than the nodes shown in *Prism. Conradi,* while in the latter even these simple nodes appear at a distance from the basal point which, in *Gongyl. Marshi*, covers nearly the entire growth of the sponge to maturity. It seems quite clear that *Prism. Conradi* exemplifies a primitive stadium of Gongylospongia.

HYDNOCERAS, Conrad.

1842. *Hydnoceras*, Conrad. Journal Philadelphia Academy of Natural Sciences, vol. viii, p. 267.

1863. *Dictyophyton*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., pp. 84, 87, 90, 91.

1874. *Dictyophyton*, Larkin. The Alfred Student (May), p. 53.

1879. *Dictyophyton*, Schimper. Zittel's Handbuch der Palaeontologie; Palaeophytologie, p. 69.

1880. *Dictyophyton*, F. Roemer. Lethæa Palæozoica, p. 128.

1881. *Dictyophyton*, Whitfield. American Journal of Science, vol. xxii, pp. 53, 132.

1882. *Dictyophyton*, Whitfield. Bull. No. 1, Amer. Mus. Nat. Hist., p. 10.

1882. *Dictyophyton*, Zittel. Neues Jahrb. für Mineral., etc., vol. ii, p. 203.

1883. *Dictyophyton*, Barrois. Ann. de la Soc. Géol. du Nord, vol. xi, pp. 80–86.

1883. *Dictyophyton*, Hinde. Cat. Fossil Sponges British Museum, p. 130.

1884. *Dictyophyton*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 466, 472, 473.

1887. *Dictyophyton*, Hall. Sixth Ann. Rept. N. Y. State Geologist, pp. 36–38.

1889. *Hydnoceras*, Beecher. Mem. Peabody Museum, vol. ii, pt. 1, p. 14.

1889. *Dictyophyton*, Neumayr. Die Stämme des Thierreichs, p. 228.

1895. *Dictyophyton*, Zittel. Grundzüge der Palaeontologie, p. 52.

Obconical, more or less rapidly expanding sponges, with an acute or subacute base furnished with a short, often obscure tuft of anchoring spicules. The surface, in elementary stages smooth, soon develops eight prism-faces and thereafter prominent nodes arranged in horizontal and vertical rows, each node normally lying at the intersection of adjoining prism-faces. These nodes, therefore, correspond in number with the prism-angles, and are normally eight in any horizontal row; the number of horizontal rows in the adult condition varying from four to eight. Abnormalities in place of appearance of the nodes are not infrequent. The nodes may be small and acutely triangular or very broad and semi-ovoid in outline. The extremity of each is furnished with a small tuft of spicular rods. By the development of the nodes the prism-faces of the body of the sponge are greatly obscured. The surface also bears short erect lamellae connecting the nodes of any vertical row, and it is probable that there were similar erect lamellae, both vertical and horizontal, which correspond to the principal reticulating bands. About the aperture the surface is slightly expanded and the margin is smooth and free of prostalia.

Type, *Hydnoceras tuberosum*, Conrad.

Notwithstanding the fact that CONRAD's term HYDNOCERAS, based upon the now well known species, *H. tuberosum*, was introduced under the conception that the fossil represented an aberrant or extravagant type of orthoceran cephalopod, there is nothing in the etymological construction of the name that of itself conveys any erroneous notion of the structure. Consequently it seems proper to rehabilitate this finely characterized genus of sponges with its first appellation, and restore to Mr. CONRAD the credit for its discovery and first description. It was, in fact, at Mr. CONRAD's own suggestion, that his name gave way to the later term DICTYOPHYTON,* and, as elsewhere observed, although this term has been generally adopted in the literature of these fossils, it seems the wisest plan to discontinue it, not because it was founded on a misconception but because it perpetuates one. The specified type-species of DICTYOPHYTON were three in number, representing according to our present

* See Sixteenth Ann. Rept. N. Y. State Cab., p. 87.

understanding three distinct genera; none of these, however, are nodose species of the Hydnoceras type.

The genus is well characterized, definitely restricted and most abundantly developed in the Chemung sandstones of New York.

Hydnoceras tuberosum, Conrad.

Plate ii, Figs. 5-7; Plate iii, Figs. 1, 2, 4; Plate iv, Figs. 2-4; Plate v, Figs. 3. 4; Plate vi, Fig. 3; Plate vii, Figs. 2, 3; Plate viii, Figs. 1, 2; Plate xxxviii, Figs. 1, 2.

1842. *Hydnoceras tuberosum*, Conrad. Journal Philadelphia Academy of Natural Sciences, vol. viii, p. 267, pl. xvi, fig. 1.

1863. *Dictyophyton tuberosum*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90, pl. iii, fig. 1.

1880. *Dictyophyton tuberosum*, F. Roemer. Lethæa Palæozoica, part 1, p. 128.

1883. *Dictyophyton tuberosum*, Hinde. Catalogue Fossil Sponges British Museum, p. 130, pl. xxviii, fig. 3.

1884. *Dictyophyton tuberosum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 473, pl. 17 (18), figs. 7, 8.

Not *Dictyophyton tuberosum*, Barrois. Annales de la Soc. Géol. du Nord, vol. xi, p. 82, pl. 1, figs. 1a–e. 1883.

Sponge of ample dimensions, turbinate or obconical, expanding with regularity and moderate rapidity; aperture not contracted. Transverse section of the body of the cup normally subcircular or obscurely octagonal, but usually subelliptical from compression. Surface bearing strong, elevated, subangular nodes which are distinctly arranged in two series, one horizontal, the other longitudinal. The horizontal rows do not, in any mature individual observed, exceed four or five, and each row is separated from the next adjacent by a regularly and broadly concave constriction. The vertical rows are, normally, eight in number, and these usually present the aspect of four double rows, the concavity of the surface between adjoining double rows being noticeably deeper than that between nodes of the same double row. The effect of this arrangement into double rows is heightened by the compression of the cup. The nodes are low, subacute or blunt, with broad bases connected vertically by sharp, slightly elevated ridges which cross the transverse constrictions, and horizontally by quite shallow depressions. In the most slender examples the height of these nodes, measured from the greatest depth of the horizontal constrictions, is not more than one-seventh of the full diameter of the cup; in robust individuals and young sponges it is very much less.

These nodes lie at regular intervals along the margins of appressed prismatic longitudinal faces, and, presumably, at the intersection of such ridges with horizontal spicular bundles of the first order. Instances of irregularity in the development of these nodes are very frequent, indeed it is rarely that the normal number and order of the nodes is retained in full-grown examples.

Reticulum. The specimens of this species are preserved as external and internal casts in sandstone. The very extensive material which has been under examination has not furnished a single instance in which the parts of the spicular skeleton have been indicated except as impressions in the sandstone. Such impressions are, however, very sharp, and afford a complete conception of the gross structure of the skeleton. The surface is very regularly reticulated by vertical and horizontal series of spicular bands. The vertical bands of the first order are, as already observed, those along which the vertical rows of nodes are arranged and correspond to the angles of the elementary prism-faces; the horizontal bands passing over the nodes do not, however, appear to be perceptibly larger than their neighbors. The general appearance presented by the surface is that of regular quadration by subequilateral rectangles, whose size varies with the individual, and the number of which between any two nodes in a vertical row also appears to be an individual peculiarity. In a slender example, one of these quadrules measures approximately 5 mm. on each side and there are nine of them between two nodes, while in a very robust individual they measure about 10 mm. on each side and there are six between successive nodes.

When the surface is well preserved, four distinct series of rectangularly reticulating bands may be observed within each of these quadrules. External casts of the cups, broken in a favorable manner, show that the vertical bands connecting the nodes were produced beyond the surface, and this we may infer to have been the condition of all the larger bands; thus producing an exterior somewhat similar to that of CLATHROSPONGIA, though these lamellae are broader in the latter genus. As these longitudinal lamellae rise over the bases of the nodes they become much broader, expanding to form a flattened triangular tuft at the apex of each node, often greatly extended, and considerably broader than the depth of the node. From the summit of the node, at the center of this triangular expansion, extends a stout bundle of spicules to and beyond the apex of the lamella (see Plate vi, fig. 3). Upon internal casts of *H. tuberosum*, there is frequently an irregular depression or pit at the summit of each node, and it may be inferred therefrom that the proximal ends of the central tufts have left these cavities (see Plates iv and v).

Mode of growth. The young *Hydnoceras tuberosum* is an anodose, narrowly turbinate cup, in the primitive stage obconical and thereafter with eight flat or slightly convex sides. The tendency to form nodes is first indicated by low swellings a little distance above the base. At a short interval there is another row slightly more prominent than the first, but neither of these is sufficient to obscure the prismatic form of the cup (see Plate vii, figs. 2, 3; Plate viii, figs. 1, 2).

It has been mentioned above that four or five transverse rows of nodes characterize the adult of this species. This statement is intended to refer only to the fully developed nodes, which may be preceded, over the basal and prismatic parts of the cup, by one or two rows of incipient nodes; further, individuals will occasionally bear a subapertural row of low supernumerary nodes. The frequent irregularity in the development of the nodes is due to various causes. A node may fail to appear at its proper place without causing any irregularity in the reticulum (compare Plate ix, fig. 2, where in the two lower rows there is one node wanting, the normal number being filled only in the third row by the abrupt appearance of a full-sized node). Many of these irregularities of development or growth are due to injuries to the cup, which the sarcode of the animal quickly repaired, but the net-work once broken was rarely fully restored to its proper pattern. Figure 2 on Plate vii shows a cup which suffered a rent or break in the net-work at an early stage of development, and this has left its traces in all subsequent growth. The irregularity shown in figure 1, Plate iii, apparently produced by some accident to the cup, has most effectually modified the shape of the sponge. On Plate vii (figure 3), is shown a cup on which, as a result of injury, a node lies in one of the horizontal constrictions and produces a slight deformation, from which the sponge shortly recovered. The disappearance of the nodes towards the aperture may be abrupt or gradual. The apertural surface is moderately broad and smooth, distinctly expanded, and, as shown in several instances, not fringed or tufted on the margin as in the lower Carboniferous genus Lebedictya.

The characters of this species as above given have been chiefly derived from specimens obtained at the locality known as the Brown hill school-house, four miles west of Wallace, Steuben county, N. Y. A remarkable colony of these sponges was there discovered in 1877, when, by the grading of an old road, several hundred specimens of the species were turned out of the superficial rock-beds, and since that time systematic operations have produced many more. It has been found that this colony is quite restricted in its

extent, though it is highly probable that its resources are not yet exhausted. Probably not less than two thousand specimens have already been collected at this spot within a radius of five hundred feet from the district school-house situated on the roadside. The species occurs here almost to the exclusion of other organic remains. We have a record of three other sponges, *Hydnoceras rhopalum*, *Hydriodictya patula* and *Actinodictya placenta*, represented by single specimens, and also of a few crinoids and an occasional brachiopod. It is especially important to observe that in this prolific development, variations from the specific type, so far as the great amount of material studied would indicate, are altogether rare, if not absent. The uniformity of specific characters is maintained throughout all the variations in size and development. In the vicinity of this locality specimens have been found at various points within a mile to the west and south, and all of these occurrences appear to be at about the same geological horizon; they may prove to be offshoots or extensions of the *Brown hill colony*.

Elsewhere the species occurs in its normal proportions at somewhat widely separated localities in the northern part of Steuben county and the southern part of Ontario county. A short distance north of the village of Avoca, on the land of the late THOMAS COTTON, specimens occur in abundance but in an inferior condition and showing a constant tendency to assume the characters normal to the species *H. Avoca;* they have recently been found in great numbers by Mr. D. D. LUTHER, about two miles southeast of the village of Naples, Ontario county. The species has, in fact, the most general distribution in the Chemung rocks of any of the Dictyosponges, but it does not range high in this series of faunas; although the specimen described by CONRAD was stated to have come from Addison, Steuben county, no examples of the species from so high an horizon have come under our observation.

The discovery of similar nodose sponges in the Psammites du Condroz, of France, the equivalent of the Chemung sandstones of New York, has been recorded by BARROIS.* The fossil which this author has referred to *Dictyophyton tuberosum*, Conrad, seems to represent a species clearly distinct from any of the known American nodose forms, as is indicated by its deep horizontal constrictions, sharp prismatic faces and low carinate nodes situated on broad and stout horizontal annulations. This fossil is described and figured elsewhere in this volume under the name, *Hydnoceras Barroisi*, and in

* Sur les Dictyospongidæ des Psammites du Condroz; (Annales de la Société Géologique du Nord, vol. xi, p. 80, pl. i, 1883).

connection therewith other nodose species from the same formation, most kindly submitted by Professor Barrois.

Dimensions. The material studied shows wide differences in respect to size. Some comparatively small individuals indicate full growth, while occasionally much larger specimens evince immaturity in the development of the nodes. The specimen figured on Plate v (fig. 4), is a very good example of an average individual, its original length having been about 200 mm. A large but slender cup has a length of 280 mm., with a greatest diameter of 95 mm., while a shorter example, 220 mm. in length, has a maximum width of 135 mm.

Localities. In the lower and middle portions of the Chemung sandstones; in the town of Italy, Yates county, and in the southern part of Naples, Ontario county; at various localities in Steuben county principally west of the Cohocton river, Brown hill school-house, Potter hill, scattered localities in the towns of Howard and Avoca. The species also occurs, though rarely, in the Jenks quarry at Bath.

Hydnoceras tuberosum, Conrad,

var. glossema, var. nov.

Plate vii, Figs. 4, 5; Plate ix, Fig. 2.

This name is introduced for a form distinguished from *H. tuberosum* by its slender, very gradually expanding cup, with low, horizontal constrictions and depressed, subacute nodes in five or six well-developed rows. The variety is based upon several specimens whose dissimilarity from forms of *H. tuberosum* is very apparent. In both of the specimens figured the spicular net work is finer, that is the principal quadrules are smaller than in *H. tuberosum*. The specimen on Plate ix, fig. 2, is interesting for the traces it shows of annelidan tubes, suggesting a commensalism, similar evidences of which have been observed in other Dictyosponges. (See page 81, and also remarks on Symbiosis in the Hexactinellida, page 21.)

Locality. In the sandstones of the Chemung group, in New York. Both examples are from unknown localities, but probably from the middle portion of the group in northern Steuben county.

Hydnoceras Bathense, sp. nov.

Plate iii, Fig. 3; Plate viii, Fig. 4; Plate ix, Fig. 1.

This species has the same general form of cup as *Hydnoceras tuberosum*, but is distinguished from that by the greater number of horizontal rows of

nodes in the mature individual, there being usually five or six well developed rows, and also by the size of the nodes themselves, which are strongly elevated, compressed laterally and have an elongated semielliptical or oval outline. The height of these nodes is often equal to one-third and sometimes even to one-half the diameter of the body of the cup. Their summits are almost invariably wanting, indicating a tufted reticulum at these points. The subprismatic surface of the cup is less clearly retained than in *H. tuberosum*, and the rate of expansion and the concavity of the horizontal constriction is less pronounced.

Sponges with these characters well defined have thus far been found largely localized in the neighborhood of Bath, N. Y., where the specific traits described are maintained by multitudes of individuals. Away from this locality there seems to be a progressive modification in the form of the nodes, which lose their elongate tapering outline and gradually approach their very distinct expression in the species, *H. Aroca*. The predominance of these two forms under different geographical conditions justifies their description as distinct species notwithstanding the desultory occurrence of passage forms in other localities.

Locality. *Hydnoceras Bathense* is exceedingly abundant at the Jenks quarry, one mile south-east of the village of Bath, Steuben county, where it occurs in thin shaly layers between two heavy compact beds of greenish sandstone, whose fine grain has preserved the lines of the reticulum with much distinctness. In association with it at this locality occurs an occasional specimen of *H. botrædema*. Outside of the *Jenks quarry colony*, typical specimens have not been found.

HYDNOCERAS BOTRŒDEMA, sp. nov.

PLATE II, FIG. 4.

SPONGE rather small, slender, very gently expanding; with four horizontal rows of very strong digitiform nodes separated by deep horizontal constrictions. Over these concave areas the surface of the cup is totally without trace of the prismatic surface shown in allied species, and when uncompressed is circular in section. The body of the cup, were the nodes removed, would be very narrow and quite cylindrical. The nodes are arranged in eight vertical rows, which are, in reality, four double rows, and any two adjacent members of these double rows arise from a common and thickened base. Nearly one-half the height of these nodes from the bottom of the horizontal constriction upwards, is below the level of the concavity dividing their proximal surfaces. Thus each pair of nodes stands upon an elevated base. The

direction of the nodes of any pair is divergent and to such a degree as to bring the summits of all the nodes to about the same interval. Each node is laterally compressed and projected downward, so that each horizontal row presents a circlet of eight drooping, almost pendulous pouches.

Reticulum rather fine-meshed.

Dimensions. The species does not vary much in size. An average example measures from apex to aperture, 135 mm.; its greatest width, across the top row of nodes, is 60 mm.; the diameter of the body of the cup at the subapertural constriction is 33 mm.

The characters of this species are pronounced and readily recognized. Its small size, subcylindrical body, elevated rows of double nodes, and the elongate, recurved form of the latter give it an expression not otherwise reproduced.

Locality. The species occurs in hundreds at a locality known as Irish hill, near the village of Bath, Steuben county. All the specimens that have been examined from this spot (the *Irish hill colony*) were found loose in the fields and no systematic excavation has been made for them into the underlying rocks. It also occurs, though not abundantly, in association with *H. Bathense* in the *Jenks quarry colony*. Away from the immediate vicinity of Bath the fossil has not been observed.

Hydnoceras Avoca, sp. nov.

Plate ii, Figs. 1, 3; Plate ix, Fig. 3; Plate x, Fig. 1; Plate xi, Fig. 1.

This form of Hydnoceras is rendered very distinct by its short, broadly expanded nodes, very stout and wide at the base and with a subsemioval outline. The number of horizontal rows of nodes is usually four or five, including the incipient row near the base. The horizontal constrictions are narrow and deep, and the prismatic surface is obscurely retained. All the forms of this species observed indicate great size at maturity, as shown by the specimens represented on Plates x and xi. That on the latter plate is the largest nodose sponge yet seen and must have had a length when entire of not less than 625 mm., or about 2 feet. Reference has been made above to the occasional occurrence of passage forms from *H. Bathense* to this species, but the two represent sharp extremes of variation in the form of the nodes.

Locality. *Hydnoceras Avoca* is represented in the material under study by perhaps a dozen specimens from the vicinity of Avoca, Steuben county. Their precise position in the rocks has not yet been ascertained as the specimens, most of them collected by the late Thomas Cotton of that village, have been found loose. There is no satisfactory evidence of their occurrence

in the Dictyosponge colony of *H. tuberosum* upon the farm of Mr. COTTON. The large example referred to was taken from the foundation wall of a ruined mill in the village of Avoca. A single example with the characteristic nodes of the species comes from the Jenks quarry, Bath, N. Y.

HYDNOCERAS PHYMATODES, sp. nov.

PLATE VI, FIGS. 4, 5; PLATE XXXVII, FIG. 3.

SPONGE distinguished from other species of this genus by its broadly expanded form and small, abundant nodes. The basal portion of the cup is anodate for some distance, and the eight prismatic faces are clearly apparent though somewhat obscured, the nodes of the vertical rows being connected by longitudinal ridges which are also clearly defined over their summits. Towards the base of the cup these nodes are in eight longitudinal rows, but near the middle or toward the aperture this number is increased by intercalation to nine, ten or eleven. The specimen figured on Plate VI shows the introduction of a single vertical line of nodes at the fourth horizontal row (counting the incipient row near the base), and on the opposite side of the cup the abrupt appearance of two new lines in the fifth horizontal row. The cup also shows faint evidence of an eighth subapertural horizontal row. The specimen shown on Plate XXXVII has similar irregularities in the number and appearance of the nodes. All of these nodes are low, with rounded margins and surfaces sloping nearly equally in all directions, the concavities between the members of each horizontal row being nearly as deep as those between successive rows. The horizontal constrictions are thus very shallow; they are also closely approximate and distinctly marked by the elevated edges of the vertical prismatic faces.

Reticulum fine, the various series of spicular bands not being very distinctly defined.

Dimensions. Specimens of this species are usually much compressed laterally, probably, however, without much exaggeration of the actual rate of expansion of the cup. The figured example has the following dimensions: Length, 180 mm.; greatest width, 83 mm.; height of nodes, 5 to 8 mm.; distance between the horizontal rows of nodes, about 10 mm. A larger example has somewhat stouter and less rapidly multiplying nodes.

Localities. In the schistose Chemung sandstones near Bath, Steuben county, N. Y. The species is rare at this place, and its occurrence can not be given more precisely. A specimen of much smaller size but of similar

aspect, has been found by D. D. Luther in the lower Chemung beds at Italy hollow, Yates county.

Hydnoceras hypastrum, sp. nov.

Plate vii, Fig. 1.

Among the specimens obtained from the late Rev. Jonathan Allen, of Alfred, is one showing in cross-section a cup with a circular or subcylindrical body and eight very strong nodes in four pairs. Each pair is raised on an elevated base as in *H. botrædema*. These nodes are very long and droop toward the base of the cup. Though the summits of all are broken, sufficient is retained to indicate their great size and length. The greatest diameter of the specimen between the broken extremities of the nodes is 130 mm.; the diameter of the cylindrical body, 57 mm. Though the fragment indicates a form similar to *H. botrædema*, the nodes are proportionally larger and the cup itself of much greater size than in that species. It is probable that when better known this form will prove to be distinct from the others here enumerated.

Locality. In the Chemung group; from a greenish sandstone in association with *Cryptodictya Allenі*; probably from the lower part of the series in Steuben county, N. Y.

Hydnoceras euthieles, sp. nov.

Plate viii, Figs. 5, 6; see also Plate xxxiii, Fig. 7.

This form, which is represented by two very similar fragments from the same locality, combines in a certain measure the form of *H. Bathense* with the pendulous nodes of *H. botrædema*. The sponges are short, expand rather rapidly and show obscure evidence of the prismatic faces; the horizontal rows of nodes were probably not more than four in number; the nodes themselves are extremely long, somewhat compressed laterally, the outline being incomplete at their extremities, thus indicating a strong spicular tuft at these points. In the elongate form of the nodes the species is even more extreme than *H. botrædema*, while it lacks the subcylindrical body and slender form of the latter.

Dimensions. The better of the two examples has a length of 80 mm. from the aperture to the end of the third horizontal row of nodes, which could not have been far from the base of the cup. Its diameter at the aperture is 90 mm.; between the two lower rows of nodes, 38 mm. One of the nodes has a length of 25 mm.

Localities. In the schistose Chemung sandstones, on the farm of THOMAS COTTON, near Avoca, N. Y. Associated with this species here are great numbers of a coarsely meshed sponge, probably *H. tuberosum*, which is always poorly preserved; also, *H. multinodosum*, *Arystidictya elegans*, *A. nodifera* and *Hallodictya Cottoniana*. Reference has already been made to the probable presence of this species in the Portage group at Varysburg, Wyoming county (page 70).

HYDNOCERAS MULTINODOSUM, sp. nov.

PLATE XXXIX, FIG. 1.

Among the specimens from the Dictyosponge colony at Cotton hill, the great majority of which are very large though usually imperfect individuals approaching *Hydnoceras tuberosum*, are a few fragments indicating a species of this genus noteworthy in its size and the remarkable abundance of nodes. The best of these specimens is that figured, which represents the upper part of a large cup laterally compressed, as is the case with all the sponges at this locality. Three transverse rows of nodes are shown on the exposed side, the lower bearing eight, the middle one ten, and the upper, which appears to be the apertural row, seven. All are small and low. The adventitious character of many of these nodes is evident from a comparison of the different rows; thus one incipient node in the lower row is not represented in either of the others; similarly one node of the second row has no equivalent above or below, while another is represented in the top row but not in the lower. The total number of nodes in each upper row must have been not less than from 14 to 20, a feature which at once distinguishes the species. The more conspicuous nodes in the vertical rows are connected by slightly elevated ridges or remnants of the prism-angles. The apertural width of the fragment is 180 mm., its length 110 mm.

Locality. In the lower Chemung group, one mile north of Avoca, Steuben county, in association with *H. tuberosum*, *Arystidictya elegans*, *A. nodifera*, *Hallodictya Cottoniana*, etc.

HYDNOCERAS LUTHERI, sp. nov.

PLATE VIII, FIGS. 7–10.

SPONGE very small and graceful, very gradually expanding, prism-faces greatly obscured, growth usually regular. The rate of expansion from the base to the first row of nodes is greater than elsewhere except about the aperture. The nodes are well developed, with rounded extremities, and are arranged in three or four horizontal rows which are separated by very

broad depressions. When there are but three rows of these nodes, the first or lowest is sharply developed, and at times there is evidence of an obscure row in the apertural region, as shown in one of the specimens figured. When the four rows are normally developed those of the first row are small and incipient. The aperture is situated at somewhat less than the usual interval above the last row of nodes, and is expanded to nearly the full diameter of the cup at the last row. The number of nodes in each row, while normally eight, is sometimes but seven on the earliest rows.

The *reticulum* is fine, usually sharply retained, and shows primary spicular bands midway between the nodes both longitudinally and horizontally. The tufted extremities of the nodes are seldom preserved in the specimens examined.

Dimensions. Nearly all the examples of this diminutive and graceful species are entire, a most unusual occurrence among species of this genus. One such individual, mature in all its characters, has a length of 40 mm., a width at the first nodes of 8 mm., greatest width of 13 mm. and an apertural diameter of 12 mm. A somewhat stouter specimen has the same length but a maximum diameter of 20 mm. Individuals much smaller than either of these have also been observed.

Locality. In the sandstones of the lower part of the Chemung group. Nearly fifty individuals, characterized by their slender form and persistently small size, have been found by D. D. Luther, in a single loose slab, in Segur's gully, township of Italy, Yates county, N. Y. Specimens of *Hydnoceras tuberosum* occur in the same rock.

Hydnoceras rhopalum, sp. nov.

Plate xxxvii, Figs. 1, 2.

This form, found only in the Brown hill colony of *H. tuberosum*, is too unlike the latter to justify its being regarded as an abnormal individual expression of that species.

The sponge is elongate and slender, its most expanded portion at two-thirds of its length from the base, having about thrice the width of the fractured lower end. Nearly the entire lower half of the cup is devoid of well developed nodes, though showing distinctly, under compression, the prism-faces.

The number of horizontal rows of nodes is large, but the nodes themselves are seldom conspicuously developed. These rows, counting all which show incipient nodes, are eight or nine in number, and appear to bear normally eight in each row, but in several instances they are irregular in this respect,

nodes failing to appear at their proper position. The upper portion of the cup is somewhat distorted from accident and the mending of the net-work.

The *reticulum* is similar to that in *H. tuberosum*.

Dimensions. This specimen has a length of 125 mm., which is nearly the original extent of the sponge. At the lower extremity its width is 13 mm. Where broadest, the width is 36 mm.

Locality. Lower Chemung sandstone, Brown hill school house, near Wallace, Steuben county. (Collection of E. B. HALL.)

HYDNOCERAS VARIABILE, sp. nov.

PLATE XXXVI, FIG. 1; PLATE XXXVII, FIGS. 4–6.

SPONGE of moderate size; expanding slowly from the base for one-third or nearly one-half of its length, thence upward widening more abruptly over the node-bearing surface. The form is thus somewhat more slender below than in other species and is further characterized by an apparent absence of nodes over the basal region, or if not altogether absent their existence is only suggested here and there. Normally there appear to have been not more than three horizontal rows of nodes over the expanding portion of the cup. In all the internal casts representing the species these are low and the full number, eight, is seldom developed. Fragments of the lower parts of the cup are so nearly free of nodes as to fail to even suggest the genus HYDNOCERAS. Yet when a specimen is retained in its matrix, as shown in figure 1, on Plate XXXVI, this apparently anodate basal surface is found to have borne sharply defined nodes nearly to the apex. As ordinarily preserved the specimens are very variable in their general aspect, not only on account of irregularity of appearance in the nodes but also because of the irregular expansion of the reticulum. The fundamental prism-faces are almost wholly obliterated even on the basal portions of the cup.

Reticulum. The net-work appears on internal casts to be coarse, on account of the predominance of the secondary spicular bands forming meshes measuring about 2 mm. on each side. The general aspect of the reticulum is a composition of such rather coarse meshes, but these are more or less distinctly subdivided.

Dimensions. A specimen, the most nearly entire of any observed and having the nodes well developed, is 125 mm. in length and probably its original length was not less than 140 mm. At the lower end its width is 30 mm.; its greatest width 65 mm.

Locality. From the lower beds of the Chemung group, not more than one hundred feet above the Portage sandstones, at Deyo basin in the southern part of the town of Naples, N. Y.

Associated with it are *Ceratodictya annulata, Spirifer mesacostalis, Atrypa hystrix, Productella lachrymosa, Ambocœlia umbonata, Hystracanthus*, sp., etc. (Collected by D. D. Luther.)

Hydnoceras nodosum, Hall (sp.).

Plate ii, Fig. 2.

1863. *Dictyophyton nodosum*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 91, pl. iii, fig. 2.

1884. *Dictyophyton nodosum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 472, pl. 17 (18), fig. 6.

"A fragment two and a half inches in length, being an impression in shaly sandstone, preserves the marks of longitudinal ranges of rounded nodes there being six [five] nodes in each longitudinal row in the length indicated.

"This species differs from the preceding [*H. tuberosum*] in having longitudinal rows of nodes more nearly parallel, smaller and more clearly arranged in rows, while they are not angular. The surface is finely reticulated by longitudinal and transverse striae.

"*Geological formation and locality.* In the shaly sandstones of the Chemung group in Cattaraugus county (N. Y.)." (*op. cit.* 1863.)

This is a small species which appears to have some resemblance to *H. botrædema* in its slender cup and strong nodes though possessing one more horizontal row of nodes than any examples of the latter species have yet shown. Nothing closely comparable to the original specimen has been observed, and hence our knowledge of the specific form is still quite imperfect.

Hydnoceras anthracis, sp. nov.

Plate ii, Fig. 8; Plate vi, Figs. 1, 2; Plate xxxiii, Figs. 8, 9.

Sponge small, narrow and gracefully expanding for one-third of its length, thence upward gently contracting to a well-defined constriction just below the aperture.

Surface sharply prismatic for nearly one-half the length of the cup. Not until the sponge attains its full diameter do nodes appear and these manifest themselves with some irregularity. In the single entire specimen observed

there are but three transverse rows of nodes, and in the lowest row but three of the normal eight nodes are distinctly developed, three others are merely suggested while two are absent. In the second and third rows all nodes are present but are unequally developed. The fragment of a second and somewhat larger specimen shows four transverse rows of nodes. All of these nodes are small and are elongated by the prism-angles on which they lie. Their presence does not materially obscure the fundamental prismatic form of the sponge.

In full development each node is prominent, its height equalling about one-fourth of the diameter of the cup. They are directed gently downward and distinctly tufted. The upper or apertural portion of the sponge is smooth for a considerable distance and noticeably expanded. The margin is regular.

Reticulum fine, the principal spicular bands being those at the angles of the prism-faces, with a corresponding horizontal series dividing the constrictions between the nodes. The remainder of the net-work is subequally divided into quadrules measuring about 1 mm. on each side, and these are again divided by a single series of bands.

Dimensions. An entire specimen has a length of 60 mm., a greatest width of 20 mm. and an apertural width of 17 mm. Other specimens indicate about the same proportions.

A very interesting feature of this species is the retention of a pronounced prismatic surface, the late appearance of the nodes and their feeble development. Other species demonstrate the relationship of HYDNOCERAS to PRISMODICTYA, but in none is the connection so clearly shown as in this later and probably degenerate form.

Localities. A rare species, which has been observed only in the higher beds of the Chemung group, in a very compact green sandstone at Scio and Wellsville, N. Y. (Collection of E. B. HALL.)

HYDNOCERAS EUMECES, sp. nov.

PLATE XII, FIGS. 1–3.

This is a very large species with narrow, elongate, sharp nodes and narrow prism-faces. The original specimen has been greatly compressed vertically, but shows features which are not possessed by the other species of the genus. This is indicated, first by the dimensions of the fossil, the internal cast having a diameter of 180 mm., while the distance across the cup as indicated by the external impression, was about 225 mm.; a size not surpassed in any known specimens of this genus. The example affords no conclusive

evidence of the number of horizontal rows of nodes, but the nodes themselves are seen to be low and sharp, prolonged into acuminate tufts, separated from adjacent members of the same horizontal row by a shallow depression, while the horizontal constrictions between the rows are very deep. The interval between such of these nodes as are shown on the external and internal casts indicate the normal number of eight vertical rows. The spicular bands have left sharp impressions, the prevailing size of the quadrule being 6 mm. on a side, this being divided by a subordinate series of bands.

Locality. From the upper portion of the Chemung group at Alfred, Allegany county, N. Y.

Hydnoceras, sp.

Plate viii, Fig. 3.

A much distorted and broken specimen from the compact green sandstones of the upper part of the Chemung formation at Wellsville, N. Y., indicates still another species of this genus, in which the nodes are small but prominent, the prismatic faces sharply defined and concave, and the reticulum very fine. Its characters are, however, too obscure to ensure a correct diagnosis.

BOTRYODICTYA, gen. nov.

Dictyosponges consisting of two distinct parts; the lower subcylindrical or very gradually expanding and without surface ornamentation; the upper part a subturbinate cup, very strongly and complexly nodose. These two parts are divided by a sort of diaphragm evidently produced by the interweaving and thickening of the reticulum internally at the base of the cup. The upper part of this sponge has the aspect of Hydnoceras, the compound pouch-shaped nodes being arranged in horizontal rows; the lower part resembles Dictyospongia.

Type, *Dictyophyton ramosum*, Lesquereux.

Botryodictya ramosa, Lesquereux (sp.).

Plate xiii, Figs. 1-8.

1884. *Dictyophytum ramosum*, Lesquereux. Description of the Coal Flora of the Carboniferous Formation in Pennsylvania and throughout the United States, vol. iii, p. 827. (Second Geological Survey of Pennsylvania, Rept. P.)

1889. *Dictyophytum ramosum*, Lesley. Dictionary of Fossils, vol. i, p. 200.

Original Description: "Stem nodose or tubercular at the articulations, the tubercles projecting outside at right angles to the stem, as short branches, inflated and button-like at the apex.

"This species may be a form of *D. tuberosum*, Hall, l. c., p. 90, pl. iii, fig. 1, which has the articulations inflated into short, obtuse tubercles, some of them broken, but none prolonged as branches. The specimens I have had for examination represent the tubercles arranged in horizontal rows, as in *D. tuberosum*, but instead of being round and obtuse they are prolonged horizontally into short branches inflated into half round knots at the apex. The ribbon-like divisions surrounding the stems and branches are parallel and quite distinct.

"*Habitat.* Upper Chemung, head of Hill creek, Charleston township, Tioga county, Penna. A. Sherwood."

The foregoing description, based upon a conception of the vegetable nature of this organism, was derived from highly imperfect specimens. It might in fact, be difficult to recognize, in the absence of illustrations, the form which it is intended to portray, were it not that we have specimens collected from the same locality by Mr. ANDREW SHERWOOD, and that these represent the only nodose Dictyosponge known to occur there. The fossil has proven to be a remarkable and extremely interesting one, and by careful manipulation of the very badly collected material representing it, it has been possible to elucidate the main features of its structure.

SPONGE, in general form, stout and subturbinate, resting upon a long, subcylindrical, hollow base or pedicel. The latter expands very gradually, is subcircular in cross-section and smooth on the exterior. Toward its upper portion it broadens where passing into or joining the vase-like upper part of the sponge. Its length seems to be variable, irrespective of variations in the size of the nodiferous vase; where best preserved it is considerably longer than the vase, and even here its basal point is not retained. In this instance its width is about one-fifth that of the body of the vase, and this varies but little from top to bottom except at the proximal expansion.

Form and general aspect of the upper part or vase as in HYDNOCERAS. Body of the vase subcylindrical, somewhat rapidly expanding beneath, and slightly contracting at or near the aperture. Surface covered with a series of compound irregular, pendulous lobes or pouches which are arranged in eight vertical and four horizontal rows, these being separated by low vertical depressions and deeper horizontal constrictions. The specimens are so preserved that most of these nodes are greatly flattened and somewhat distorted from their normal shape, though those lying in the plane of lamination of the rock have generally escaped such distortion. The structure of these compound nodes is essentially as follows: Of the three lower horizontal rows, each rises

from the surface of the vase with a stout body which, at some little distance above that surface, is divided by a vertical and a horizontal groove, usually of unequal depth. These grooves make a division of the surface into four lobes of irregular form and distinctly pendulous; upon the lowest horizontal row the two lobes of the inferior division of the node are very long and confluent for a considerable distance, producing digitiform pouches. Those of the median rows appear to be somewhat less elongated, but all have a downward direction. There are some irregularities in the division of the nodes. In one instance the horizontal groove is wanting, leaving but two nodes on the lobe; in another, one of the four lobes appears to be divided into three, and the other into two parts. The uppermost, or apertural, series of nodes differs from the rest in having the lobes short and arranged singly or in simple pairs which seem not to correspond invariably in position with the vertical rows in which the lower nodes are arranged. The growth of the nodes in this row was, however, quite irregular; they are short, and while in some specimens they are erect and in others inclined downward, their normal position was probably directly outward. No specimen is sufficiently perfect to indicate precisely the number of nodes in this row.

A slight variation from the type of structure described is indicated by one example which shows a coalescence of, or an indistinctness between the first and second horizontal rows of nodes at their base and also a partial loss of the quadrilobed surface of the second row. Each specimen, however, presents its peculiar modifications in the number and form of the nodes and lobes.

Reticulum. Over the pedicel the spicular bands are extremely fine, but the reticulation is distinct. Toward the base of the cup the longitudinal bands become prominent while the horizontal bands are obscured. On the vase, the net-work is fine in comparison with that of Hydnoceras, and the obscurely subprismatic form prevailing in that genus is here totally lost. The quadrules of the most prominent series measure about 2 mm. on each side, and these are crossed by one or two finer series. Over the lobes the spicular bands all spread apart as in Hydnoceras. There is no satisfactory evidence of spicular tufts at the extremities of the nodes, though presumably such tufts existed; nor are there other spicular expansions except fine, narrow, longitudinal laminae following the courses of the larger spicular bands.

Toward the base of the cup there seems to have been a thickening of the spicular strands which on the inner or gastral side of the sponge apparently converged to an apex near the union of the cup with the pedicel. This internal convergence is exhibited in several instances where the sponge has been

broken transversely at this point. There is no evidence that the pedicel is filled up with spicular deposits and hence the convergence of the spicules of the cup forms a sort of diaphragm which permits a ready separation of the parts at this place.

Dimensions. Of two of the best preserved examples, one measures as follows: Entire length, 170 mm., of which 93 mm. appertain to the incomplete pedicel. Width of pedicel, 10 mm.; apertural width of cup, 68 mm. The other specimen has a length of 160 mm., of which but 63 belong to the pedicel; the median diameter of this cup is 45 mm., and the apertural width about 52 mm.

Locality. In greenish sandy shales belonging to the upper part of the Chemung group, near Lawrenceville, Tioga county, Pennsylvania.

BOTRYODICTYA (or TYLODICTYA), sp.

From the upper beds of the Chemung group at Scio, N. Y., have been obtained a few fragments of a quite small species which show compound and pendulous nodes. These doubtless represent a species either of BOTRYODICTYA or TYLODICTYA. (Collection of E. B. HALL.)

HELICODICTYA, gen. nov.

Dictyosponges with funnel-shaped or explanate skeletons, bearing equidistant spiral surface ridges.

Type, *Helicodictya trypania*, sp. nov.

HELICODICTYA TRYPANIA, sp. nov.

PLATE XXII, FIGS. 1, 2.

The specimen upon which this species is founded shows an elongate, funnel-shaped cup of small size, subcylindrical for nearly one-half its length from the base, expanding more rapidly above. Of the basal portion both external and internal casts are preserved, but of the upper part only one surface is retained. The cup is characterized by a series of strong parallel, nearly equidistant spiral ridges, from 4 to 5 mm. apart, which appear to have been extended into short, erect lamellæ. The continuity of these ridges about the entire surface of the cup is clearly shown upon the internal cast.

Reticulum composed of sharply defined and minute meshes, the spicular bands lying parallel and perpendicular to the spiral ridges. The latter appear to correspond to the vertical ridges in PRISMODICTYA. The texture of the reticulum is extremely fine, there being scarcely any visible distinction in the

size of the quadrules. In some parts of the specimen the prevailing quadrule appears to be somewhat less than 1 mm. square and this is subdivided by one or two subordinate pairs of spicular bands. The entire surface shows twelve of the spiral ridges and the last two interspaces near the apertural extremity are divided medially by a much fainter ridge and elevated line.

Dimensions. Entire length of the specimen, which seems to be approximately the original length of the cup, 70 mm.; width at the base, 9 mm.; at 30 mm. above the base, 15 mm.; at its greatest diameter, 30 mm.

Locality. In the upper beds of the Chemung group at Wellsville, N. Y. (Collection of E. B. Hall.)

The following species are referred to this genus provisionally. They indicate a spiral mode of growth but their structure is too imperfectly known to render the definite determination of their generic characters possible.

Helicodictya (?) Concordia, sp. nov.

Plate xxvii, Fig. 2.

The single specimen of this fossil is subfusiform in outline, with a depressed upper surface; expanding from its lower, subacute extremity through somewhat more than one-half its length, thence broadly contracting without revealing any definite evidence of an aperture at the upper end, although the margin here is entire for a portion of its extent. The surface is crossed by spiral ridges at wide and enlarging intervals. These ridges are three in number and on the left margin of the specimen are about 10 mm. apart, this interval increasing on the right margin to 15 or 18 mm. The two upper intervals are each divided in the middle by a finer ridge parallel to the others. There are no reticulating ridges of corresponding size. The net-work is composed of fine spicular bands among which none is conspicuously predominant, though the prevailing quadrule measures about 2 mm. on a side and is repeatedly subdivided. The length of this specimen is 60 mm. and its greatest width 35 mm.

While this specimen presents a specific aspect rendering it distinct from associated forms, there is no very good reason for regarding it as congeneric with *Helicodictya trypania* or as a genuine spiral Dictyosponge. Upon comparison of this with the specimen figured on Plate xvii (fig. 1), the similarity in the character of the reticulum in both may be a reason for inferring that the spiral direction of the ridges in *H. (?) Concordia* may be wholly casual, as the example referred to evidently represents the apertural portion of a regularly expanding cup, whose divergent ridges are vertical.

Locality. From the upper beds of the Chemung group; in the *Prismodictya prismatica* colony, at Concord station, Erie county, Pennsylvania.

HELICODICTYA (?) SCIO, sp. nov.

PLATE XXVII, FIG. 1.

SPONGE moderately large and apparently regularly expanding. Surface crossed by subequidistant spiral ridges from 17 to 20 mm. apart, revolving from left upward and over to right. These are parallel to one series of spicular bands, the principal reticulating series making therewith quadrules measuring about 10 mm. on a side. The length of the original fragment is about 70 mm.; its width at the lower extremity 33 mm. and at the upper extremity 55 mm. Its surface bears four spiral ridges.

The reason for placing this form among the spiral sponges is simply the aspect of the best preserved specimen. While the specific form may be distinct, the evidence afforded by a second example indicates that the generic reference here provisionally employed may be of doubtful value.

Locality. In the upper beds of the Chemung group at Scio, Allegany county, N. Y. (Collection of E. B. HALL.)

RHABDOSISPONGIA, gen. nov.

Elongate, broadly and strongly annulated sponges, fluted by vertical ridges.

Type, *Dictyophyton Amalthea*, Hall.

RHABDOSISPONGIA AMALTHEA, Hall (sp.).

PLATE XVI, FIG. 1.

1890. *Dictyophyton Amalthea*, Hall. Ninth Rept. N. Y. State Geologist, p. 58; Forty-third Ann. Rept. N. Y. State Museum, p. 260.

SPONGE slender, expanding very gradually, gently curved near the base; transverse section probably circular. In the original specimen the base is wanting, but the remainder of the surface bears five broad and deep transverse constrictions which increase in width toward the aperture. These give to the cup the appearance of being strongly annulated, the annulations increasing in breadth with the constrictions. The area about and below the aperture is without constriction at the usual interval. The surface is ornamented by a series of distant, longitudinal, narrow spicular ridges, diverging toward the aperture with the expansion of the cup. Six or seven of these are visible upon the exposed surface but no other trace of the reticulum is apparent. The interspaces between these narrow ridges are flat and broad.

Dimensions. The only known example has a length of 280 mm. from the aperture, which appears to be entire, to the broken basal extremity; a width of 70 mm at the aperture and 20 mm. at the lower end.

This description is based upon a plaster cast of a specimen formerly in the possession of the late Rev. A. H. Riley, of Montrose, Pennsylvania, but the present ownership of which is unknown.

Locality. In the upper beds of the Chemung group at Great Bend, Susquehanna county, Pennsylvania.

CERATODICTYA, gen. nov.

Elongate, gently expanding cups, transversely annulated and without predominating ridges or other surface ornamentation.

Type, *Dictyophyton annulatum*, Hall.

Ceratodictya Carpenteriana,* sp. nov.

Plate xlii, Fig. 1; Plate xliii, Figs. 1–3.

Sponge extremely elongate, slender, very gradually and regularly expanding. Sometimes the cup assumes a gentle crescentic curve which appears to be not abnormal though one specimen of considerable length is straight throughout its extent. The surface is covered by strong, regular, continuous, duplex annulations separated from each other by deep grooves, both grooves and annulations having about the same width over the median portion of the sponge. The annulations are rendered duplicate by a transverse groove on each, which under compression and especially on the incipient portions of the skeleton, may sometimes approximate in breadth the interannular grooves. Each annulation is thus divided into two well-defined ridges rounded at their summits and with their deeper slope toward the interannular grooves. Some variation is apparent in the form of these annulations during the process of growth. Near the basal point the summit grooves are relatively much broader than at any later growth-period, and although all observed specimens of the species are noteworthy for the stability and uniformity of the annulations, yet the example figured on Plate xliii (fig. 2), shows that the second annulation which is, in fact, the upper member of the divided first annulation, is itself faintly duplicate. As growth continues beyond maturity the interannular grooves become diminished in width, and apertural fragments of full grown and old specimens show that both grooves and annulations are much

* Thus named as a token of respect and esteem for Mrs. Fannie Hall Carpenter, daughter of E. B. Hall, Esq., of Wellsville, N. Y.

diminished in prominence, though the duplication of the latter is still more pronounced than in *Ceratodictya cincta*.

The *reticulum* is very fine-meshed throughout, with no evidence of any especially predominating series of spicular bands. The prevailing mesh measures about 1 mm. on each side and is subdivided by a single minor series. There is no evidence of any ornamental projections from the surface in the form of tufts or spicular ridges.

Dimensions. This sponge is remarkable for the great length which it attained. Plate xlii shows one excellently preserved specimen, incomplete, however, at both ends, having a length, measured along its gently curving axis, of 317 mm. In its entire length it bears thirteen double annulations, the earliest of which, measured from the outer edges of the ridges, is 15 mm. wide, and the last of them has about the same width. A second fragment (Plate xliii, fig. 2) is nearly complete at the base and is straight for a distance of 365 mm., the remainder being lost. The very long specimen shown on the same plate (fig. 1) measures 500 mm. in length, with slight curvature, and is complete at neither end. Fragments of the apertural end of full grown or old specimens found in association with those referred to, have a much greater width. One of these, doubtless of this species, is 130 mm. wide and to have attained this width at the rate of increase shown in other specimens, the entire sponge must have been not far from three feet in length. Allowance is, in this estimate, made from the very evident fact that the sponge expanded much more rapidly during the first one-third of its length than in later growth.

Localities. All the more extended specimens have been obtained in the upper beds of the Chemung group, on MILO COLE's farm, near Ischua, Cattaraugus county. A single fragment of an old individual is from Randolph, N. Y. Associated with it in the soft greenish shales at the former locality are specimens of *Lingula*, *Camarotœchia* and *Spirifer*. (Collection of E. B. HALL.)

CERATODICTYA CINCTA, Hall (sp.).

PLATE XXII, FIGS. 7–9.

1884. *Dictyophyton cinctum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 472.

SPONGE large, subcylindrical, showing slight evidence of tapering, and though much compressed, evincing a normally circular cross-section. Surface bearing closely-set, subequidistant, narrow and strong annulations separated by furrows equal to them in width. These form a purely ornamental configuration of the surface and have no other relation to the reticulum. The reticular

net-work is extremely fine and homogeneous, no large quadrules being present. The prevailing mesh is about 1 mm. square and is subdivided by a subsidiary pair of spicular bands. These cover the entire surface both of the annulations and furrows, without the intersection of any coarse bands.

The entire dimensions of the cup are unknown. A large fragment with a length of 120 mm. bears eight annulations, the height of each being about 5 mm. The diameter of this specimen is 120 mm. On one side of the cup the growth of the annulations has been interrupted, evidently from accident, and in the repair of the reticulum the regularity of the annulations has been greatly disturbed. This species will be distinguished from the terminal expanded portions of *C. Carpenteriana* by more regularly equidistant annulations.

Locality. In the sandstones of the Chemung group; from a boulder at Erie, Pennsylvania. Portions of several individuals occur in the same fragment of rock and with them is the original specimen of *Ceratodictya zonata.* (Collection of the Philadelphia Academy of Natural Sciences.)

Ceratodictya zonata, sp. nov.

Plate xli, Fig. 6.

1884. *Dictyophyton cinctum*, Hall (*partim*). Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 473.

Sponge small, slender, gradually expanding. Surface crossed by broad and low annulations which are separated by narrower and shallow constrictions toward the basal extremity which is wanting. These horizontal rings are not sharply defined; those over the median and distal parts of the cup are flattened or somewhat depressed on their summit. There are eight annulations in a length of 45 mm.

Reticulum exceedingly fine, all of the quadrules being minute. The most conspicuous of the spicular bands are represented by sharp horizontal lines at the bottom of each constriction.

Length of the only observed specimen 53 mm.; diameter at the lower end, 6 mm.; greatest diameter 14 mm.

Locality. In the arenaceous beds of the Chemung group; from a boulder found at Erie, Pennsylvania. (Collection of the Philadelphia Academy of Sciences.)

CERATODICTYA ANNULATA, Hall (sp.).

PLATE XXII, FIGS. 3-6.

1863. *Dictyophyton annulatum*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90, pl. iii, fig. 3.

1882. *Dictyophyton annulatum*, Hall. Notes on the Family Dictyospongidæ, pl. 17, fig. 5.

1884. *Dictyophyton annulatum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 472, pl. 17 (18), fig. 5.

SPONGE slender, very gradually expanding, straight or slightly curved; cross-section circular.

Surface smooth, annulated by a series of low, horizontal constrictions, varying somewhat in depth, and much narrower than the successive swellings of the cup. Over the basal portion of the cup the constrictions occur at much wider intervals.

Reticulum fine, without the strong predominance of any series of spicular bands. The prevailing quadrule appears to measure about 2x3 mm., and is repeatedly subdivided.

Dimensions. The original specimens are three in number and the best of these has a length of 80 mm., and a width of 21 mm. On this specimen there are five annulations in a length of 63 mm. A somewhat larger, more completely flattened example retains nearly the entire cup, a portion of the base being wanting. The original length of the cup was about 85 mm.; the diameter of its apertnre 34 mm. This specimen bears but one constriction and hence two annulations, the lower half of the cup being regularly conical.

Localities. The orginal specimens are from a sandy shale of the upper Chemung group in western New York; their precise locality, however, is not known. With them are associated the brachiopods *Ambocœlia gregaria* and *Rhynchonella duplicata*. The specimen represented on Plate xxii (figs. 3, 4) is from the lower beds of the Chemung formation at Deyo basin, Naples, Ontario county, where it is associated with *Hydnoceras variabile* and *Hydriodictya cylix*.

CERATODICTYA CENTETA, sp. nov.

PLATE XLI, FIGS. 1-5.

A small colony of annulated Dictyosponges has recently been found in a soft sandy shale which was evidently deposited about the growing cups so that the greater number of the specimens cross the sedimentation-lines of the rock at large angles, and have, in consequence, been variously compressed and

distorted. Some, which became detached or lay more nearly parallel to the lines of deposition, are better preserved, though in none of the examples is the entire form retained.

These sponges vary considerably in form and size, the young individuals being slender with broad or narrow annulations at unequal distances. The larger individuals have the annulations more regular and equidistant. All the annulations are, as a rule, low and rounded, with broad and shallow interspaces. In a specimen measuring 57 mm. in length and having a width at the upper end of 24 mm., there are six annulations at subequal intervals; a young example 46 mm. long, with a width at the top of 12 mm., and at the bottom of 7 mm., has six annulations at somewhat irregular intervals. The largest fragment observed has a diameter of 40 mm. The reticulum in all of these specimens is fine and shows no predominant spicular striae, the prevailing mesh being uniformly from .5 to 1 mm. square. The species is distinctly unlike any of the other forms referred to this genus and although having an aspect somewhat similar to that of *C. zonata*, differs from this in its less regular and unflattened annulations as well as in the character of its reticulation.

Locality. In the upper part of the Chemung group at Ischua, Cattaraugus county, N. Y. About fifty individuals were found in place distributed over a very limited area.

CLATHROSPONGIA, Hall.

1863. *Dictyophyton*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90.

1882. *Clathrospongia*, Hall. Notes on the Family Dictyospongidæ, Expl. pl. 18, figs. 3–4.

1884. *Dictyophyton* (*Clathrospongia*), Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 468–470,474.

1890. *Dictyophyton*, Hall. Ninth Ann. Rept. N. Y. State Geol., pp. 57, 58.

This term was introduced without definition and was intended to cover, in a subgeneric sense, the species *Dictyophyton abacus*, Hall, which presents a strong development of the erect reticulating surface lamellae such as also occur in the genus Thysanodicty a. Unlike the species of the latter genus, however, the form of the cup is regularly obconical, and it appears to terminate below in an acute point. There is still some uncertainty in regard to this character, but nevertheless the differences in the form of the cups, and the characters of their earlier growth are evident. It has been found necessary in the consideration of a number of different species where imperfect preservation has precluded definite knowledge of the basal structure, to refer to this

genus some forms which, when better known, may prove to belong in some other association. Indeed, in the type-species only are the generic features clearly defined, and hence the group must for the time being serve in a measure as a convenient receptacle for certain imperfectly known forms.

Type, *Clathrospongia abacus*, Hall. (See description of this form among the species of the Waverly group.)

CLATHROSPONGIA FENESTRATA, Hall (sp.).

PLATE XIV, FIG. 2; PLATE XXV, FIG. 5.

1863. *Dictyophyton fenestratum*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90, pl. iii, fig. 4.

1884. *Dictyophyton fenestratum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469.

The original specimen of this species is a very incomplete fragment of a moderately large cup, a portion of whose surface, involved in soft green shale, retains the exterior character of the reticulation, while the remainder of the specimen is only an internal cast of the skeleton. This specimen gives no accurate idea of the form of the cup, except that it was subcylindrical with an essentially smooth exterior, but an internal cast of a more complete example from the same locality as the original furthers our knowledge of the species.

SPONGE of considerable size, elongate subcylindrical through most of its length, with a short, rapidly expanding basal portion. Transverse section subelliptical or subcircular. Surface with only traces of low nodes at the angles of the principal quadrules.

Reticulum in its external character, composed of quadrules of which the principal series measures about 12 mm. on the side. The horizontal and vertical bands of the first series are of about equal prominence and at their intersection distinct nodes are formed. These main quadrules are regularly subdivided by four subordinate series of spicular bands and upon the internal cast almost all distinction between these series is lost, the ultimate subdivision of the quadrules being nearest the internal surface of the cup.

It is evident that the principal spicular bands were produced outward in the form of free lamellae; at one spot on the cast these show a width of about 2 mm.

Dimensions. The original specimen has a length of 105 mm. and a width of 45 mm. A second example measures 138 mm. from base to distal extremity, and for five-sevenths of this length the diameter of the cup is 45 mm. The basal cone has a length of about 30 mm.

This species bears some resemblance to *C. caprodonta* of the Waverly group, but differs from it in the smaller size of the principal quadrules of the reticulum, its more cylindrical form and more abruptly tapering base.

Locality. In the upper beds of the Chemung group, Chemung narrows, N. Y.

Clathrospongia vascellum, Hall (sp.).

Plate xxi, Fig. 12; Plate xxv, Fig. 4.

1890. *Dictyophyton vascellum*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 57; Forty-third Ann. Rept. N. Y. State Museum, p. 259.

The original specimen of this species is a large, explanate fragment indicating a flattened cup, one of whose transverse diameters is six times the other. In its normal condition the cup must have been large, quite rapidly expanding and probably regularly conical in shape. The extreme length of the fragment is 188 mm. and the slope of the lateral margins would indicate a length from the upper edge of the specimen to the base, of 260 mm., making no allowance for the unknown extent of the cup beyond this upper limit of the specimen. The surface bears a series of low, broad vertical bands or obscure ridges, which are crossed by somewhat more obscure transverse bands, making a series of large quadrules, a little longer than broad, and measuring on an average about 26x30 mm. The specimen is an internal cast, and the intermediate series of meshes are obscured by the predominance of the ultimate and penultimate quadrules.

Several fragmentary examples of this species have been observed, all of them being somewhat water-worn. That here figured is the largest and most complete, affording specific characters not easily confounded with those of other species.

Locality. From the upper portion of the Chemung group; drift at Alfred, Allegany county, N. Y.

Clathrospongia (?) tomaculum, Hall (sp.).

Plate xviii, Figs. 5–6; Plate xxi, Fig. 11.

1890. *Dictyophyton tomaculum*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 58; Forty-third Ann. Rept. N. Y. State Museum, p. 260.

Sponge long, slender, probably normally subcylindrical or very gradually expanding, though the original specimen is flattened and somewhat arched laterally. The length of this specimen is 135 mm. and neither the apertural nor basal parts of the cup are retained. Its diameter at the lower end is 50 mm. and at the upper end 60 mm.

Reticulum. The surface is covered with the fine reticulations of the ultimate spicular bands, but these do not obscure the coarse ridges of the primary bands. The latter form quadrules which are somewhat broader than long, and measure on the average 17x15 mm. The vertical bands appear to be somewhat stronger than the primary horizontal series, and this gives a slight subprismatic aspect to the surface.

This sponge is not greatly unlike *Clathrospongia fenestrata;* a more complete knowledge of both may demonstrate their identity; with our present information however, *C. tomaculum* appears to have been a rather more slender cup, with a coarser primary reticulation.

A small fragment of a second specimen retains the definition of the surface characters much more sharply. Here each of the principal quadrules is divided by a subordinate pair of spicular bands, which are nearly as prominent as those of the first order, and the finer subdivision is clearly shown in its ultimate division, each principal quadrule containing 256 minimum quadrules, produced by the intersection of five series of spicular bands.

Locality. From the upper part of the Chemung group; in a loose block at Alfred, Allegany county, N. Y.

CLATHROSPONGIA (?) IRREGULARIS, Hall (sp.).

PLATE XV, FIGS. 6, 7.

1884. *Dictyophyton irregulare*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 470.

SPONGE small, gently tapering, very faintly subprismatic. In the original specimen, which is an internal cast, these prism-faces are much obscured, partly by compression and partly, also, by the surface reticulation.

The surface is divided into major quadrules by transverse bands equidistant with the edges of the prism-faces, thus forming squares measuring about 9 mm. on a side, at each of the angles there being a low node. All of these characters are, for the most part, very obscure, but sufficient is preserved to show that, in its original condition, the sponge was divided into strong quadrules as described, these being tufted at their angles. The subordinate reticulation of the surface is normal.

Dimensions. The single example of this species is complete at neither extremity, though probably little is wanting at the upper end, and its basal extent is indicated by the slope of the sides. The length of the part retained is 65 mm.; the original length was probably not more than 75 mm. The greatest diameter of the cup is 25 mm.

Locality. This sponge was obtained many years ago at Ithaca, N. Y., by Prof. F. W. Simonds. Its precise position in the strata there, whether from the beds of the Portage or from those of the overlying Chemung rocks of the vicinity is not known.

Clathrospongia (?) desmia, sp. nov.

Plate xxv, Fig. 3.

A fragment of the surface of a flattened cup indicates, in the absence of decisive generic characters, a species distinct from any of the forms elsewhere described. The primary and secondary spicular bands are so nearly of the same size that the surface appears to be divided into vertical rectangular parallelograms which measure on the average, 3 mm. on the base and 6 mm. in height; that is, the horizontal bands over the entire extent of the exposed surface are about twice as far apart as the vertical bands, and all leave impressions of about the same strength upon the external cast. The predominant rectangles are divided into squares, by faint transverse bands. All of the principal spicular bands form erect lamellae without producing nodes at their intersections. The form of the quadrule in this species is somewhat similar to that prevailing in *Dictyospongia sceptrum*, but we are without evidence of the existence of spicular lamellae in that species and genus. In *Thysanodictya rudis* and *T. Randalli* the quadrules are larger and more nearly square. The length of the fragment is 90 mm. and its greatest width, 40 mm.

Locality. In the upper beds of the Chemung group near Alfred and at Scio, Allegany county, N. Y.

THYSANODICTYA, gen. nov.

Subcylindrical or tapering Dictyosponges with prominent, projecting, rectangularly reticulating spicular bands or lamellae forming series of fenestrated quadrules upon the surface, as in Clathrospongia. Base ending abruptly in a transverse disk or broad and shallow reticulated obcone or basin, which may be encircled by an expanded basal frill, as in Phragmodictya.

Type, *Dictyophyton Halli*, Hall.

Species of this genus combine some of the characters of the two genera last mentioned, and while the form of the sponge is similar to that of Phragmodictya, it lacks both the irregular surface ridges of that genus and also the regularly radiated reticulum of the diaphragm or basal

surface. In THYSANODICTYA the reticulation of this surface is rendered regularly quadrate by the crossing of the strands which are vertical in the wall of the cup; the margins of the base are frequently puckered into low and irregularly disposed nodes, the peripheral frill being produced directly from this margin. The aspect of this surface is somewhat similar to that in the species *Oncosella catinum*, Rauff, from the Wenlock limestone*, although the latter is a thick-bodied sponge, and in this respect unlike THYSANODICTYA. RAUFF is disposed to believe that ONCOSELLA possessed one or more tufts of anchoring spicules, though they have not yet been found, and that, therefore, the sponge was not yet attached by this flattened base. Presumably, in THYSANODICTYA, the basal attachment was essentially effected by the encircling frill-like tuft.

It may be added that all the species of this genus now known show evidence of a sixth series of reticulating spicular bands, which produces an extremely minute ultimate division of the quadrules.

THYSANODICTYA EDWIN-HALLI, nom. nov.

PLATE XXIV, FIGS. 1–9.

1890. *Dictyophyton?* (*Phragmodictya*) *Halli*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 59; Forty-third Ann. Rept. N. Y. State Museum, p. 261.

SPONGE generally small, obconical or subclavate, narrowest above the base, rapidly expanding to the aperture; very variable in form, sometimes long and extremely slender, at other times short and stout. Base somewhat expanded, nearly flat, in some instances apparently concave; nodose on the periphery and with a broad marginal spicular frill extended downward or over the surface of attachment.

Reticulum of the lateral walls coarse, the main spicular bands forming vertically elongate quadrules measuring on an average 7x11 mm. The size of these quadrules varies greatly in different individuals and in different parts of the same individual. The subordinate reticulation even to the last degree, is often retained, but does not in any way obscure the predominance of the main ridges. These vertical and transverse ridges of the first and second series are expanded into lamellae which lie vertical to the surface of the cup and are free for a width of from 2 to 4 mm. At the base of the cup the vertical ridges thicken and form a single series of sharp, nodiform peripheral ridges which may extend for a short distance on the surface of the flattened or

* See RAUFF; Palaeospongiologie, Part 1, p. 264, pl. vii, figs. 5–10 (especially fig. 7). 1894.

depressed basal diaphragm. The basal frill (*periloph*, Rauff) is broad and where best retained appears to be gently undulated, but this expansion is not so preserved as to show clearly the character of the reticulation. The basal diaphragm is slightly convex or even concave, and bears a low but coarse rectangular reticulation.

Dimensions. A well developed individual of rather large size, measures 60 mm. from aperture to base. The aperture is 48 mm. and the base 26 mm. in diameter; the width of the cup across the constriction just above the base is 20 mm. A very slender example is 82 mm. in length, 30 mm. in diameter at the aperture, 11 mm. at its narrowest point and 13 mm. across the base which is not entire. In still another specimen, which may be somewhat compressed vertically, the length is but 20 mm., the diameter of the aperture 27 mm., and that of the base 25 mm. In an individual about 50 mm. in length and having a basal diameter of 25 mm., the basal expansion or frill has a diameter of about 17 mm. A single example surpasses the usual dimensions of the species, presenting a length of 175 mm. and even thus incomplete.

Localities. In the upper arenaceous beds of the Chemung group at Wellsville, N. Y. This usually small species has been found here by Mr. E. B. Hall in considerable quantities. About fifty specimens, all from the same spot, have been examined and these we are informed represent but a small part of the number there obtained. It also occurs at Scio, Allegany county, Ischua, and Olean, Cattaraugus county, and has been found on the Cassadaga creek in Chautauqua county.

Thysanodictya pœcilus, sp. nov.

Plate xxiv, Figs. 10, 11.

Sponge somewhat variable in form; short and robust or long and slender; subcylindrical, contracting above the base for less than one-half its length, and again expanding to the aperture, whose diameter is about equal to that of the base. Basal disk very depressed, almost flat; margins thickened and also extended into a peripheral frill.

Reticulum having the general expression of that in *Thysanodictya rudis*, though the elongate rectangular primary quadrules are regularly smaller, each comprising four parallelograms measuring on an average 4x6 mm. At the base and near the aperture these areas are more nearly square. The primary spicular bands are sharply elevated, minutely nodose at their extremities upon the external cast, and both the vertical and horizontal series are carried out into broad, erect lamellae which have a diameter of from

3 to 5 mm. At the intersection of these lamellae, somewhat thickened nodes or tufts are formed which extend beyond the edges of the lamellae themselves. The aperture appears to be without evidence of a marginal tuft. The basal disk is somewhat thickened and bears ridges at the margins, but the character of its surface and that of the peripheral frill is not well shown.

Dimensions. Four examples of this species are preserved upon a single slab of sandstone. Of the best two of these, one measures 100 mm. in length; diameter at the base (exclusive of marginal expansion), 55 mm.; at the aperture, 53 mm.; at the narrowest portion of the cup, 37 mm., and, with the surface lamellae, 46 mm.; the other, a much more slender cup, has a length of 120 mm. (incomplete), an apertural diameter of 30 mm. and a narrowest diameter of 22 mm.

This species is distinguished in its stouter form, from *Thysanodictya rudis*, and in its more slender form, from *T. Edwin-Halli*, by the smaller size of its primary quadrules.

Locality. In the upper beds of the Chemung sandstones, associated with *Camarotœchia* and *Leptodesma*, Scio, Allegany county, N. Y. (Collection of E. B. HALL.)

THYSANODICTYA RUDIS, Hall (sp.).

PLATE XIX, FIG. 7; PLATE XXIII, FIGS. 1–6.

1863. *Dictyophyton rude*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90, pl. v, fig. 3.

1884. *Dictyophyton rude*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469.

1890. *Dictyophyton scitum*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 58; Forty-third Ann. Rept. N. Y. State Museum, p. 260.

SPONGE moderately large, cylindrical. Base subtruncate, closed by a broadly obconical diaphragm. Surface sharply divided by a series of vertically elongate quadrangles which, in the middle portion of the original specimen, appear to be all of approximately the same size. Each of the quadrules of the first order embraces four of these rectangles and measures, on an average, 15x18 mm. Toward the base of the cup these primary quadrules are more nearly square. The bands of the first and second series form low nodes at their intersection and both the vertical and horizontal series are produced into erect lamellae which may extend outward from the surface for a distance of from 3 to 5 mm. The third, fourth and fifth series of spicular bands are seldom clearly developed, being to some extent obscured by the ultimate division of

the reticulum produced by the sixth series of bands. The presence of this series produces 1024 divisions in each primary quadrule. The conspicuous ridges of the lateral surfaces extend over the broad, subconical base, the vertical bands converging at the apex and the horizontal bands being distinctly concentric. The basal cone is shown in two examples, in one of which it is attached to a portion of the cup and is extremely compressed laterally. In the other, such distortion as it has undergone is in the opposite direction, vertical rather than lateral. The latter specimen represents a cup with a diameter of about 80 mm., bears a decidedly eccentric apex and shows the characteristic coarse and minute reticulation of the surface. The depth of this cup is 17 mm.

Dimensions. All specimens of this species observed are of about the same size. The original example, which is nearly entire in length though not retaining the basal cone, is 135 mm. long and 64 mm. wide. Another entire specimen has a length of 120 mm. and a width at the aperture of 70 mm.

This species is readily recognized, even in the absence of its basal diaphragm by its stout, cylindrical shape and coarse primary reticulation. It is closely allied to *T. Randalli* though rather less stout. The characters of the latter species are not, however, so well known.

Localities. In the upper beds of the Chemung group, at Little Genesee, Alma and Wellsville, Allegany county, at Ischua, Hinsdale and Olean, Cattaraugus county, and Chemung narrows, Chemung county.

Thysanodictya Randalli, Hall (sp.).

Plate xxiv, Fig. 12.

1890. *Dictyophyton Randalli*, Hall. Ninth Ann. Rept. N. Y. State Geol., p. 57; Forty-third Ann. Rept. N. Y. State Museum, p. 259.

The specimen upon which the original description of this species was based, is the upper portion of a flattened, once cylindrical cup whose surface is covered with low longitudinal and horizontal ridges which form quadrules measuring about 17x21 mm., each of these being subdivided by secondary ridges of nearly the same prominence as the first. The subordinate cancellation of the surface is very fine. At the upper extremity of the specimen where the apertural margin is retained there is some indication of a continuation of the vertical spicular bands beyond the edge of the cup. The length of the specimen is 90 mm.; its apertural diameter is 78 mm. This form is very closely allied to *T. rudis*, though present evidence indicates that the cup was

broader and the primary surface quadrules more nearly equilateral than in that species; yet it is probable that further knowledge will demonstrate the superfluity of this specific name.

Locality. In the Chemung group, associated with *Spirifer disjunctus;* Warren, Pennsylvania.

THYSANODICTYA SACCUS, sp. nov.

PLATE XXV, FIGS. 1, 2.

SPONGE short, stout, broadest at the base, narrowing upward, with gently incurving margins. Height somewhat less than the basal diameter. Circular or subelliptical in cross-section. Basal obcone or diaphragm moderately deep with a subcentral apex.

Reticulum. Primary quadrules somewhat variable in size, smaller and more nearly square than in *Thysanodictya rudis.* Subordinate divisions of the net-work clearly shown in places. The basal diaphragm is thickened or nodose about the edges and, in the specimens observed, has a somewhat irregular reticulation, though the meshes of the lateral surfaces are here to some extent retained. This species may be recognized by its short and robust form and its tapering rather than expanding cup. Two individuals from different localities show the same characters. In the better of these, one surface is covered with low, apparently concretionary tubercles which, in a measure, obscure the character of the reticulum; a phenomenon not infrequent among these fossils.

Dimensions. A typical example has a length of 74 mm., a basal diameter of 88 mm., and an apertural diameter of 63 mm. A second specimen has nearly the same proportions.

Localities. In the upper part of the Chemung group, at Wellsville and Whitesville, Allegany county, N. Y. (Collection of E. B. HALL.)

THYSANODICTYA JOHNSTONI, sp. nov.

PLATE XXIII, FIGS. 7, 8.

SPONGE robust, subcylindrical or somewhat inflated medially, and sharply constricted above the base. Basal obcone or diaphragm very shallow, nearly flat; sharply and irregularly nodose about the margin. The surface of this diaphragm is composed of fine and sharp spicular bands intersecting at right angles, the prevailing quadrule measuring from 3 to 5 mm. on a side. There are no coarse spicular ridges of a higher order distinguishable, but the reticulum shows, in addition to the regularly intersecting bands, irregularly arranged or disordered bands principally of large size. The nodes of this basal surface

are most prominently developed at the margin, taking somewhat the form of elongated ridges directed toward a common center and hence, here and there, they are to be found extending upon the inferior surface in an irregular and desultory way. The surface of the cup, in the only example in which it is retained, is covered with low nodes or coarse papillae, arranged with some degree of regularity; they show, however, no trace of the spicular net-work. This specimen is involved in a soft arenaceous shale and these rounded bodies on the surface appear to be concretionary, as in places where the rock is exfoliated they show a succession of thin laminae. Probably they have formed about the projecting points and intersections of the principal spicular strands.

Dimensions. The most complete example observed retains a large portion of the cup which has been bent over so that it lies in nearly the same plane with the basal diaphragm. Its entire length is 135 mm.; its diameter at the upper end, 67 mm.; at the middle, 78 mm.; just above the base, 53 mm. The greatest and least diameters of the base are 70 and 55 mm. Another example preserving the base only, has the major and minor diameters 85 and 55 mm.

This species may be distinguished from *T. Edwin-Halli* and *T. rudis* by its different form, extremely nodose and finely reticulate base.

Locality. In the upper beds of the Chemung group, Wellsville, N. Y. (Collection of E. B. Hall. Named for Mr. John S. Johnston, of Wellsville, in recognition of his intelligent activity in collecting the sponges of the upper Chemung group.)

Thysanodictya quasillum, sp. nov.

Plate xxxviii, Figs. 3, 4.

Sponge large and stout; general form as in the other species of the genus, with a subcylindrical body slightly expanded above the middle and at the base. The aperture is not well retained.

Surface marked by large, coarse meshes of somewhat variable size, bounded by distinct ridges which were probably bases of vertical surface lamellae. These quadrules are approximately square, the largest of them measuring about 16x14 mm. These occur about the more expanded portion of the sponge, toward the base the prevailing meshes being somewhat smaller. At the intersection of the primary bands there is a noticeable tendency to elevation in the form of low nodes. A faint subdivision of the principal

quadrules by spicular bands of the second order is visible here and there over the surface, and over the entire reticulum may be seen the extremely fine ultimate division of the skeleton. At the base the margins of the diaphragm are somewhat irregularly thickened into nodes, but the structure of the reticulum over the basal surface is not retained although the form and outline of this part are distinctly shown.

The species is distinguished from *T. rudis* and *T. Randalli* by its greater size and the coarseness of its primary meshes.

The specimen we have used for the illustration of this species shows in a very interesting manner how differently the reticulum may be retained on parts of the same individual. Figures 3 and 4 (Plate xxxviii) represent opposite sides of a specimen, on one the primary net-work only being apparent while on the other the minute ultimate division of the net is retained. This difference appears to be due to the fact that the specimen is a somewhat concretionary mass of sandstone which was involved on one side in a film of fine mud capable of retaining the impression of the most delicate spicular divisions.

Dimensions. Length of an essentially entire specimen, 140 mm.; width above the middle and at the base 85 mm.

Locality. From the Chemung group at Weston mills, Cattaraugus county, and Wellsville, Allegany county. (Collection of E. B. HALL.)

THYSANODICTYA SCYPHINA, sp. nov.

PLATE XLII, FIG. 8.

SPONGE small, subcylindrical, the original specimens being somewhat contracted at or near the aperture and having the prevailing mesh of the net-work of small size, averaging 2 to 3 mm. on a side. The species is distinguished by these characters from other members of the genus.

The basal frill is clearly retained over a portion of the lower extremity and shows a broadly crenulated or furrowed surface and an irregular margin.

Dimensions. The length of the specimen, which has been somewhat compressed vertically, is 36 mm., its basal diameter 30 mm. and the width of the basal expansion 7 mm.

Locality. In the upper part of the Chemung group, Olean, Cattaraugus county, N. Y. (Collection of E. B. HALL.)

Thysanodictya hermenia, sp. nov.

Plate xxvii, Fig. 7; Plate xxxix, Fig. 2; Plate xl, Figs. 1–3.

Sponge attaining large size; subcylindrical, expanded both at base and aperture. Primary quadrules of the wall of the cup very large, varying somewhat in size. These are generally longer than wide and the largest of them may measure as much as 42x21 mm. Such large quadrules generally lie over the median part of the sponge, those toward the extremities being shorter and more nearly square. The finer net-work is retained in places.

The length of a large specimen, incomplete at the aperture, is 250 mm.

Three specimens, two of which were evidently overwhelmed by encroaching sediments while growing in their normally erect position, afford a very clear conception of the structure of the basal plate or diaphragm, though the vertical walls of the cup have been so compressed as to wholly destroy their characters. In the matter of size, they can be compared only to *T. quasillum*, whose basal parts have not been precisely made out. Of these specimens one has a diameter of 150 mm., the other measuring to the edge of the peripheral frill, 175 mm., the base of the cup itself being 130 mm. in diameter.

No other examples of this genus have preserved so distinctly the structure of these basal parts and of these three specimens two retain the reticulum without distortion. Both show that the coarse meshes with strongly elevated spicular margins, such as characterize most other species of the genus, are continued from the lateral walls to the base, and while they present the same general aspect as do those of the upright surfaces of the sponge, their composition is distinctly different. There is no radial arrangement evident in these bands, no center of departure nor apex of attachment. The vertical bands from the lateral walls, bent abruptly into the diaphragm, cross each other from opposite sides, making, over the central portion of the base, large square meshes of the same aspect as those occuring elsewhere, but here formed only by the intersection of the vertical spicular bands.

The actual crossing of these vertical bands is restricted to the central area of the base; away from this area and in the peripheral region of the disk, the bands of both sets gradually put on the aspect of the horizontal bands of the cup and actually form such bands. There are but a few of these concentric ridges on the disk, not more than three or four of the first order, and the inner ones are somewhat squared to the quadrate form of the central area, so that the transition from the concentric to the vertical ridges

is barely noticeable on a cursory inspection. The character of this peculiar reticulation is such that four small wedge-shaped areas remain, one in each quadrant, where rectangular reticulation can not occur. These are at the sides of the broad bands of vertical spicules extending over from the lateral walls of the cup, and here the net-work is not only irregular but seems to have formed a node or tuft.

Beyond the edge of the basal plate extends a frill of considerable width, very similiar in character to that occurring in *Phragmodictya catilliformis*, but not as wide as has been observed in that species, and with a crenulated or deeply furrowed surface. At the union of the frill with the body of the sponge, low, irregular and elongate nodes are formed, as observed in other species of the genus. The more prominent of these extend outward from the periphery over the lower surface of the expansion and may become considerably elevated, with smooth, concave interspaces. The coarse reticulation of the skeleton is here visible only near the base of the frill, further outward the net-work being obscured. In the specimens under consideration the actual extent of the frill is pretty clearly defined by a discoloration of the matrix.

The strong, coarse net-work of the basal disk does not obscure the exceedingly fine ultimate reticulation which is everywhere seen. In one of the three specimens oblique compression has disturbed the regularity of the basal net-work, but the strong irregular nodes at the periphery are very pronounced. Confirmatory evidence of the view that these convex plates are basal and not apertural like the sieve-plate in EUPLECTELLA, is the following fact: The arenaceous slabs of the upper Devonian of western New York frequently have their surfaces covered with various forms of wave and ripple marks and furrows left by the dragging of pebbles, tracks of crustaceans, etc. Such surface markings were made on the soft muds which subsequently became shales, while the encroachment of more sandy sediments produced relief impressions of these configurations so that such reliefs are found upon the lower side of the sandy layers. One of these basal disks of *Thysanodictya hermenia* lies at the upper surface of such a sandy slab, its convex face downward, the compressed cup above, while the lower surface of the slab is covered with relief impressions of mechanical markings made upon the sediments immediately beneath.

Locality. In the upper beds of the Chemung group at Hinsdale, Cattaraugus county, N. Y. (Collection by E. B. HALL.)

Thysanodictya apleta, sp. nov.

Plate xxvi, Fig. 1; Plate xxvii, Fig. 8.

This name is applied to incomplete examples indicating cups of great size with a very coarsely lamellose-reticulate surface. None of the observed specimens is sufficiently complete to give a clear conception of the form of the sponge or a decisive idea of the generic character of the species.

One of the largest individuals seen is that figured on Plate xxvi; this has a length of about 275 mm. and a greatest width of 220 mm. The drawing has been made from a plaster-cast of an external impression, which shows the curvature of the surface and probably gives an approximately correct idea of the diameter of the cup, but no accurate indication of its length. So far as the original form of the cup is here suggested, it does not widely differ from that of the known species of Thysanodictya. The character of the surface fortifies this resemblance. The principal spicular bands form strong, erect lamellae, nodose at their intersections, characters which indicate the surface structure in that genus. The primary quadrules are usually square and measure about 14 mm. on a side, though very variable both in form and size. The secondary bands are usually clearly defined in all external casts, and no internal cast has been observed showing the finer meshes of the reticulum. The surface shows no other ornamentation than that described.

Localities. The largest of the specimens of this species was found loose among the sandstones of the upper Chemung at Alfred, Allegany county, associated with *Spirifer disjunctus*. Others nearly as large have been obtained at Hinsdale, Cattaraugus county, and fragments at Scio and Ischua. Smaller fragments have been received from Nile and Wellsville, localities in Allegany county, and from Olean, Cattaraugus county.

Thysanodictya turricula, sp. nov.

Plate xxxviii, Figs. 5, 6.

This is the most slender and graceful of all the species of the genus. The sponge is small and either tapers or expands upward from a relatively broad base. The surface is cancelled into narrow, elongate meshes which grow shorter about the aperture. While these quadrules may belong to a minor series, yet they are predominant upon the surface to the obscuration of others. The periloph is quite broad. These characters are well shown in the two entire specimens figured, one of which has a length of 40 mm., a basal width of 12 mm. and an apertural width of 7 mm. The width of the basal expansion

is 4–5 mm. The other has a length of 42 mm., a basal width of 10 mm., across the periloph, 18 mm. and across the aperture, 15 mm.

The species is well characterized by its elongate form, small size and the nature of its quadration.

Locality. In the upper Chemung sandstones at Wellsville, N. Y. (Collection of E. B. HALL.)

ARYSTIDICTYA, gen. nov.

This genus comprises sponges which are cylindrical toward the base but expand upward to a broad, flaring aperture, the general form of the sponge being like that of LEBEDICTYA. The lower extremity is, however, abruptly truncated by a circular, transverse or slightly convex diaphragm as in THYSANODICTYA and PHRAGMODICTYA. No basal frill has been observed.

Surface smooth or with low, irregularly arranged nodes; more or less distinctly reticulate.

Apertural region with fine, branching channels running to the margin.

Type, *Arystidictya elegans*, sp. nov.

ARYSTIDICTYA ELEGANS, sp. nov.

PLATE XLI, FIG. 10; PLATE XLII, FIG. 7.

SPONGE of considerable size. The single specimen has been compressed but was undoubtedly circular at the base and regularly obconical for about one third of its length, thence expanding abruptly to the very large aperture. The form of the cup is, thus, somewhat broadly vase-shaped.

Surface smooth, without nodes or other irregularities. Margin regular and entire.

The *reticulum* as preserved appears to be composed, over the lower part of the sponge, of rather sparse and loosely arranged spicular bands crossing at right angles and forming square meshes about 4 mm. on a side. Whatever subdivision of these meshes existed appears to have been quite irregular and the principal quadrules themselves seem to be at times crossed by deviating threads of the principal strands. Over the upper expanded surface of the cup the reticulation is not distinctly visible, the surface being smooth or covered with irregularly distributed depressions, and toward the aperture these are extended into grooves or branching channels, subparallel to one another and perpendicular to the margin.

The base of the sponge is truncated by a diaphragm the compression of which has obscured the reticulation of the surface.

Dimensions. Length 145 mm.; diameter at the base 53 mm., at the aperture, 160 mm.

Locality. In the lower part of the Chemung group at Cotton hill, one mile north of Avoca, Steuben county, N. Y. (Collection of E. B. Hall.)

Arystidictya nodifera, sp. nov.

Plate xli, Fig. 11.

In this species the cup expands somewhat more regularly than in *A. elegans*, and is of smaller size. Its surface is covered with low, vertically elongate nodes which appear to be without definite order; these are larger toward the base and become small and obscure toward the aperture, the region about the apertural margin being smooth. This margin is smooth, uninterrupted, thin and regular.

This is an interesting species, but is unfortunately known only from a part of a cup representing probably about one-half the original width.

Locality. In the lower part of the Chemung group at Cotton hill, near Avoca, N. Y., associated with *A. elegans*, *Hydnoceras tuberosum*, *H. multinodosum*, *H. eutheles* and *Hallodictya Cottoniana*. (Collection of E. B. Hall.)

HYPHANTÆNIA, Vanuxem (*emendata*).

1842. *Uphantenia*, Vanuxem. Geology of New York; Rept. Third Dist., p. 184, fig. 50.

1863. *Uphantænia*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist. pp. 84–87.

The remarkable bodies to which the term Uphantænia has been long applied, are very large, circular and shallow saucer-shaped cups, composed of two series of intersecting spicular straps, one radiating from a common center, the other concentric about the same point. The example which was described by Vanuxem under the name *Uphantenia Chemungensis* was a flattened quadrant, the original circular form of which was only inferential; but specimens of the species since found show the aperture of the cup to have been circular. In shape it appears to have been slightly elevated at the basal point, thence outward to have curved gently downward and then upward again toward the apertural margin. This at least is the form presented by what seem to be internal casts, from the sandstones of the Chemung group. The peculiar feature of this shape, however, is the upward or inward projection of the apex or base of the sponge. In the two specimens in which this part of the cup is

retained there is a small mass of sandy matrix adhering to the basal portion, though the remainder of the cup so far as retained is cleanly separated from the rock. From this it is perhaps to be inferred that the center was largely a tufted pompon of spicules whose structure is obscured by complication with the sediment.

It is possible that the normal form of the cup was the reverse of that we have suggested; instead of being saucer-shaped, it may have been broadly umbrella shaped. This is, however, less in accordance with the form usually assumed by the palaeozoic Dictyosponges which have been described, but it is a shape occasionally reproduced among living hexactinellids. The material, however, representing the genus is insufficient for the determination of this point.

From the center or basal point radiates a series of flat, gradually widening ligulate bands, with elevated or thickened edges. These bands are approximately of equal size and are subequidistant, but a slight difference in the interval between them at their origin becomes greatly increased toward the margin. There is no evidence of more than a single series of these vertical or radial bands, all of them meeting at the center. They are crossed by continuous concentric bands of similar character, though with a less palpable thickening of the margins. These regularly increase in width as they recede from the center, and the diameter of the intervals between them also increases, but less rapidly. At their intersection with the radial bands they do not lose their definition, and are probably interwoven with them as there is no evidence of their displacement at these surfaces, as would in all probability have occasionally occurred had there been no actual connexion or interlacing of the spicules.

Over the interspaces between the radial bands it is observable that the position or angle of these concentric bands is slightly changed; they do not there conform to the general curvature of the surface of the cup but are horizontal or approximately so; the effect of this arrangement is to give to each of these radial interspaces including the bounding rays a suggestive resemblance to a much inclined step-ladder.

The meshes or quadrules produced by the intersection of the two series of bands usually show only clean rock surfaces; one specimen however indicates that these quadrules have had their angles filled by a delicate parenchymal film which encroaches on the quadrules to such an extent as to leave a subcircular opening. We have no palpable evidence of the nature of the spicules composing the radial or vertical, and the concentric or horizontal bands

Their surface is smooth and usually presents such an aspect as might be produced by the pressure of fine sand grains against a thin, flat body. It is so extremely seldom that any traces of the spicular skeleton are retained in the sandstones of the Chemung group, that the absence of such evidence here is not surprising. It is possible that their structure is similar to that of the ligulate spicules observed in *Dictyspongia Marcellia*. The character of the apertural margin is not shown in any of the specimens.

Hyphantænia seems to be a Dictyosponge in which the compacting and condensation of the vertical and horizontal spicular bands has been carried to an extreme, leaving between the sharply delimited bundles broad areoles which in generic types like Hydnoceras, Dictyospongia, etc., would be subdivided by the minor spicular bands, or in Physospongia, be filled by dermalia and parenchymalia.

The only known species of Hyphantænia is the *H. Chemungensis*, Vanuxem, and of this species but five specimens have come to our knowledge, four of them being here figured.

Hyphantænia Chemungensis, Vanuxem.

Plate xxviii, Fig. 1, 2; Plate xxix, Fig. 1; Plate xlv, Fig. 1.

1842. *Uphantenia Chemungensis*, Vanuxem. Geology of New York; Rept. Third Dist., p. 184, fig. 50.

1863. *Uphantænia Chemungensis*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., pp. 84–87, figure (on p. 86).

1884. *Uphantænia Chemungensis*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 481.

1890. *Uphantænia Chemungensis*, Lesley. Dictionary of Fossils, vol. 3, p. 1246.

Sponge large, explanate, broadly saucer-shaped, or umbrella-shaped with a short base of attachment. Apertural outline circular. The radiating ligulate spicular bands, all of which depart from the center or apex, number thirty-two in the two specimens which retain this part of the sponge; the original specimen which is approximately a quadrant of the cup indicates the existence of the same number of radial bands. These, as above observed, are not always equidistant, but the irregularities in this respect are not conspicuous. The concentric horizontal bands regularly increase in width from apex to margin. What their number was in the completed cup it is impossible to say; the greatest radius of the largest specimen shows

nineteen of these and the appearance of the outermost one indicates the margin of the cup.

There is some variation in the relative proportion of the parts shown in the material at hand. The greatest radius exposed by any specimen is 192 mm.; upon this are nineteen concentric bands; upon the original specimen a radius (almost but not quite complete) of 147 mm. shows twenty concentric bands. In another example there are fourteen bands in a radius of 100 mm. There is no regular variation in size in either series of bands, but sometimes there is a slight change in the width of a concentric band; as, for example, the 15th concentric band on the original specimen measures 5 mm. at one place, and 8 mm. at another. In three of the specimens the 13th concentric band is situated at a radial distance, measuring its outer edge, of 93 mm., 92 mm. and 118 mm. In the first of these the width of this band is 4.5 mm.; in the second 3.2 mm.; in the third 5 mm. These differences are undoubtedly individual variations.

The largest example of this sponge yet observed has a greatest diameter of 347 mm.; its radius, which appears to be complete, is 192 mm. so that its full diameter was about 380 mm. or 15 inches. A smaller individual not complete at the margin has a diameter of 170 mm.

Geological horizon. In a compact and fine-grained greenish or rusty sandstone from the upper beds of the Chemung group, in the vicinity of Owego, Tioga county, N. Y. Upon one of the specimens are crinoidal segments and abundant examples of *Tentaculites spiculus.*

HALLODICTYA*, gen. nov

SPONGE growing in an explanate frond without definite limitation of its margins; in this respect similar to the genera ACTINODICTYA and CRYPTODICTYA. Surface highly irregular, moulded into circular or elongate nodes irregularly grouped, and broader swellings and depressions. Reticulation of the surface fine, regular and rectangularly developed.

Type, *Hallodictya Sciensis*, sp. nov.

HALLODICTYA SCIENSIS, sp. nov.

PLATE XXXVI, FIG. 8.

This very interesting sponge is of considerable size, showing that its explanate mode of growth was maintained in all stages. Its surface is of so

* This generic term is intended as a partial, though inadequate recognition of the important contributions to the knowledge of the Dictyosponges of the Chemung group made by E. B. HALL, Esq., of Wellsville, N. Y.

irregular a character as to convey the impression that the frond might have conformed its shape to the irregularities of the surface upon which it grew. Yet our knowledge of the mode of growth in living siliceous sponges does not favor this conception; rather, that the frond was attached at one extremity, its expanded surface free and, consequently, its irregularities not due to such conformation, but altogether idiocratic. These irregularities may be roughly classed as great and small. The former are the main depressions and elevations of the frond; the latter are groups of nodes or pits upon the surface of the former, which are probably of similar nature to the tufted node of Hydnoceras and other genera. On the exposed surface of the specimen in hand, these nodes are expressed as pits generally narrow and elongate rather than circular, and seldom occurring singly.

The *reticulum* is fine and sharp but shows only the ultimate and penultimate quadrulation, spicular bands of higher order being wholly obscured. The direction of the spicular lines indicates no convergence to any single point; those of the horizontal series curve as the contour of the surface requires, and seem to approximate a circular curvature in both the upper and lower portion of the specimen. The upper area is the better defined, and near the center of the general curvature of the spicular bands is the best defined group of small nodes upon the surface. We may thus infer a remote possibility of the attachment of the frond at more than one point, whence the growth of the spicular skeleton progressed.

This species has been observed in but a single specimen having a length of 190 mm. and a greatest width near the middle of 90 mm.

The interpretation of the obscure genus Cryptodictya, as well as Actinodictya, is made clearer by the aid of Hallodictya. In Actinodictya, the evidence of spicular reticulation is restricted to coarse, ridge-like bands which, though seeming to make, at times, quadrangular meshes, usually appear to be without much order, so that, by itself considered, there might be a possibility of misconstruction in regarding them as representing the actual meshwork of the sponge. In Cryptodictya, this condition is the more obscured by the actual obliteration of nearly every trace of the spicular skeleton except the tufts at the tips of the nodes. In this genus, however, the surface nodes are quite as strongly developed as in Hallodictya. All three genera agree in their explanate, irregular and undefined mode of growth.

Locality. *Hallodictya Sciensis* occurs in a compact siliceous sandstone at Scio, Allegany county. (Collection of E. B. Hall.)

HALLODICTYA COTTONIANA, sp. nov.

PLATE XLI, FIG. 12.

A portion of a frond, evidently of the mode of growth characterizing this genus, is less irregular than the foregoing species in the nodulation of its surface, which bears only low and inconspicuous elevations. The reticulation is quite as sharply defined as in *H. Sciensis*, but it is notably less regular and lacks even the suggestion of arrangement about any point. Notwithstanding this irregularity, the impression of the reticulum clearly pertains to one and the same layer, there being no evidence that such irregularity is due in any way to the overlapping and compression of the reticular walls.

The single specimen observed is of small size, measuring 85 by 50 mm., evidently not the entire extent of the frond.

Locality. In the middle beds of the Chemung group, at Cotton hill, one mile north of Avoca, associated with *Hydnoceras multinodosum*, *Arystidictya elegans* and *A. nodifera*. (Collected by JACOB VAN DELOO.)

ACTINODICTYA, Hall.

1890. *Actinodictya*, Hall. Ninth Ann. Rept. N. Y. State Geol., p. 59; Forty-third Ann. Rept. N. Y. State Museum, p. 261.

This genus was constituted for explanate, somewhat irregularly growing sponges, whose surface is depressed convex and whose form appears, from the aspect of the majority of specimens, to have been broadly oval. The fronds have not shown the mode of attachment, but the absence of any cicatrix, or stem, may perhaps indicate that the sponge was fixed by a marginal foot-stalk. There are among the living hexactinellids species having this explanate or leaf-shaped aspect and attached by such a stalk-like basal extension; and these bodies may be compared with the *Euryplegma auriculare* as figured by SCHULZE (Voyage of H. M. S. "Challenger"; Hexactinellida, pl. cii, fig. 1). The surface of the specimens is crossed in all directions by ridges and lines of various sizes representing the interlacing spicular bands, and yet, notwithstanding the conspicuous irregularity in the disposition of these bands, every specimen shows more or less distinctly a certain degree of rectangular reticulation among both the coarser and finer bands. The coarse bands are comparatively few in number, and the differences in size in the coarse and fine ridges are gradational and never abrupt. The irregular intersection of the various spicular bands gives the reticulum a somewhat stellate aspect.

In the living species, *Walteria Flemmingi*, Schulze (see work cited, pl. ix),

there is a very similar irregularity in the sponge meshes produced by the intersection of spicular bands at various angles, while the rectangular intersection is to some degree retained. Though Walteria is a cup-shaped sponge, the structure of its reticulum indicates that these fossil bodies, Actinodictya, are correctly construed as hexactinellid sponges.

Type, *Actinodictya placenta*, Hall.

Actinodictya placenta, Hall.

Plate xxx, Figs. 1-3; Plate xxxi, Figs. 1, 2.

1890. *Actinodictya placenta*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 60; Forty-third Ann. Rept. N. Y. State Museum, p. 262.

Sponge explanate, broadly depressed-convex, most of the specimens having a suboval though unfinished outline, occasionally with margins deflected or incurved. Surface without nodes but covered with spicular ridges of various sizes, the larger usually crossing the frond through its entire length, the smaller being traceable for a less distance; these ridges crossing one another in all directions without obscuring a certain degree of rectangular reticulation. The margins of the specimens are not defined by any of the spicular bands. The variation in size from the coarsest to the finest bands is very considerable. The surface of these fronds is usually of a darker color than the matrix, and this fact contributes to the actual appearance of the specimen in evincing the very close interweaving of the spicular bands.

Localities. This species has proven to be quite abundant in some of the lower or middle strata of the Chemung group in the vicinity of, and to some extent in association with the colony of *Hydnoceras tuberosum* at the Brown hill school house near Wallace, Steuben county. A few specimens have come from this spot itself, and about a half-mile away, upon the farm of Mr. John Roth, a considerable number of fine specimens has been collected by Mr. Jacob Van Deloo, in close proximity to the horizon of *H. tuberosum*. A few miles to the southeast, in the town of Howard, Mr. D. D. Luther has found some loose arenaceous slabs undoubtedly derived from the immediate neighborhood, and which are nearly composed of small fronds of this sponge. Among the earliest specimens of the species found are some from the upper Chemung beds near Lawrenceville, Tioga county, Pennsylvania, collected in 1879, by A. S. Sherwood. Associated with it in the localities in Steuben county are *Atrypa hystrix*, *Spirifer mesacostalis*, *Productella lachrymosa*, and *Poteriocrinus Clarkei*.

CRYPTODICTYA, Hall.

1890. *Cryptodictya*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 60; Forty-third Ann. Rept. N. Y. State Museum, p. 262.

Irregularly growing, tuberose, coarsely nodose, and probably uninclosed sponges, with a surface showing no reticulating spicular bands; the skeleton being presumably composed of extremely fine isolated spicules, except at the summits of the nodes which show evidence of short tufts of prostalia.

Although these specimens do not, of themselves, clearly demonstrate their title to a position among the hexactinellid sponges, yet in the light of the associated generic structures, HALLODICTYA and ACTINODICTYA, we are doubtless justified in regarding them as SILICEA, having a matted or felted reticulum of very minute spicules, and nodes with distinct prostalia developed at their summit.

In addition to this structure, the surface frequently presents a sort of linear striation or brush of lines departing from the nodes or sweeping irregularly over the concave spaces.

Type, *Cryptodictya Alleni*, Hall.

CRYPTODICTYA ALLENI, Hall.

PLATE XXXI, FIGS. 3-5; PLATE XXXII, FIGS. 1-4.

1890. *Cryptodictya Alleni*, Hall. Ninth Ann. Rept. N. Y. State Geol., p. 60; Forty-third Ann. Rept. N. Y. State Museum, p. 262.

SPONGES of moderately large size, with a general tendency to a suboval or elongate outline, and a depressed convex surface with abruptly deflected margins. In the majority of the best preserved examples this margin is clearly defined for more or less of its extent, showing that the form was frond-shaped or scaphate, though highly irregular and tuberose in contour and variable in outline. In one example the frond has been so enfolded by lateral compression as to bring the edges close together and produce the appearance of a nearly closed cup. The attachment of these bodies must have been either by means of a foot-stalk or by the margins of the frond. The nodes upon the surface are of various shapes and irregular in disposition; usually a number of small nodes are situated upon the summit of a large one, these being connected by a more or less sharply defined ridge, an arrangement also seen in the genus HALLODICTYA. The entire surface of the rock covered by the frond is invariably tinted of a deep chocolate or reddish brown, in strong contrast to the color of the matrix. An obscure, irregular lineation of

the surface can be made out on nearly all examples, but it is not such as to give a clew to the skeletal structure, except as we may infer that the skeleton was fine and dense, and we know that the nodes were tufted.

A symmetrical individual of suboval outline has a length of 155 mm. and a median diameter of 90 mm.; this is about the average size of most of the specimens.

Geological horizon. In the Chemung sandstones near Cohocton and Avoca, Steuben county, and at Lyndon, Cattaraugus county, N. Y. Named for the late Reverend Jonathan Allen, former President of Alfred University, Alfred, N. Y.

AGLITHODICTYA, gen. nov.

Small, button-shaped sponges, greatly expanded horizontally at mid-length, abruptly tapering to both extremities. Aperture narrow; surface finely reticulate, without nodes or other ornament.

Type, *Aglithodictya numulina*, sp. nov.

Aglithodictya numulina, sp. nov.

Plate xxv, Figs 6–9.

Sponge small, subdiscoidal, biconvex with reference to a median horizontal plane, the parts below and above this plane being subconical, that above being considerably the more depressed. Radical portion of the cup not fully retained; lateral expansion from the inferior extremity about thrice the vertical growth. The sponge attains its greatest diameter at a horizontal plane lying about three-fourths of the vertical distance from the inferior extremity to the aperture, and is thence bent sharply upwards. Upon the matrix there is some trace of an erect spicular lamella or expansion about the cup at this plane; otherwise the surface is smooth. The margin of the apertural orifice is rounded and somewhat swollen into low irregular nodes. Departing from the orifice and traversing the apertural slope to the peripheral angulation are traces of divergent surface grooves or canals such as are frequent among the lithistid sponges and are not unknown among the thick-walled hexactinellids.

The *reticulum* is exceedingly fine, but distinguishable over all of the principal exposures of the surface. There is no noticeable predominance of any spicular bands, and the quadrules are rather too indistinct to be accurately measured. The species is based on a single fairly preserved specimen in a sandstone matrix; the form is well retained and the skeleton in the usual condition of other sponges of this fauna. This specimen has a vertical length of 11 mm., a greatest diameter of 24 mm., and an apertural width of 8 mm.

Observations. It may be possible that in this species we have not a true thin-walled Dictyosponge, as its form, relatively small aperture, and the radial canals upon its surface all suggest some of the thicker-walled sponges, such for example, as those of the genus PACHYTRICHISMA, one of the dictyonine family, VENTRICULITIDÆ. (For comparison see ZITTEL, *Handbuch der Palaeontologie*, vol. 1, p. 177, *P. Carteri*, Zittel, fig. 92.) Nevertheless, such positive evidence as here presented, affords no good reason for excluding this peculiar genus, AGLITHODICTYA, from the DICTYOSPONGIDÆ.

Locality. In the sandstones of the Chemung group, near Lawrenceville, Tioga county, Pennsylvania.

SPECIES FROM THE PSAMMITES DU CONDROZ (FRANCE).

Submitted by Professor CHARLES BARROIS, University of Lille.

DICTYOSPONGIA MORINI, Barrois (sp.).

PLATE XLVI, FIGS. 1, 2.

1883. *Dictyophyton Morini*, Barrois. Annales de la Soc. Géol. du Nord, vol. xi, p. 83, pl. 1, figs. 2 a–c.

This species is one of the smooth conical sponges for which the generic term DICTYOSPONGIA has been here proposed. The specimen which we have examined represents the upper portion of the cup including the aperture, which is regular and apparently unornamented. The impression of the reticulum is obscurely retained and extremely fine. Professor BARROIS has figured not only the specimen here illustrated, but also one which retains the basal part of the cup and shows that the expansion of the sponge was gradual and uniform.

Locality. Jeumont (Departement du Nord), Brittany.

HYDNOCERAS BARROISI, nom. nov.

PLATE XLVI, FIGS. 3, 4.

1883. *Dictyophyton tuberosum*, Barrois. Annales de la Soc. Géol. du Nord, vol. xi, p. 82, pl. 1, figs. 1 a–e.

Attention has already been directed to the fact that the species described as *Dictyophyton tuberosum*, Conrad, by Professor BARROIS, in his memoir on the DICTYOSPONGIDÆ of the Psammites du Condroz, proves, after a careful revision and comparison of the nodose sponges, to represent a specific form which is not, to our knowledge reproduced among the American species of this genus. The distinctive characters of the French fossil lie in (1) the very deep and broad horizontal constrictions which render the node-bearing ridges very conspicuous; (2) the sharply defined prism-faces, their margins being distinctly continuous ridges extending from the apex and crossing the horizontal constrictions; (3) a faint median ridge dividing each of the eight prism-faces; (4) the low, elongate and sharp nodes forming ridges by fusion with the vertical prism-margins. The single specimen is broken across the third node-bearing ridge and there is, hence, no means of inferring the number of such

horizontal ridges in the total length of the sponge. There is still another feature in which this species differs from *H. tuberosum*, viz.; (5) the prevalence of a very fine network, the meshes being of subequal size, contracting over the constricted areas. Large quadrules such as are usually found in *H. tuberosum* are wanting. Professor BARROIS's excellent figures of this species show the curvature of the sponge, which seems to be probably an accidental feature of the specimen.

Locality. In compact greenish sandstone of the Psammites du Condroz (=Chemung group of New York), Jeumont, Brittany.

HYDNOCERAS JEUMONTENSE, sp. nov.

PLATE XLVI, FIGS. 5, 6.

This form is represented by several more or less compressed specimens in which the cup is broad and has somewhat the aspect of the Chemung species, *H. phymatodes*, though with coarser, less abundant and less regular nodes.

The form of sponge is rather broadly turbinate, its lower portion being distinctly prismatic for a considerable distance from the apex. The horizontal constrictions appear to be rather narrow and shallow, while the node-bearing ridges are decidedly elevated and often quite broad. The nodes themselves are elongate and those of the vertical rows are more or less distinctly connected by the ridge at the angle of the prism-faces. A remarkable character of the species is the rapid multiplication of nodes. At the base of the sponge the number of the prism-faces appears to be, as normally, eight, but even on the first node-bearing row, nodes may appear on the interspaces between the angles of the prism and as many as twelve nodes may be counted upon the second row in one of the specimens. The increase by intercalation is not, however, always so rapid, as another example shows nine, with an incipient tenth, in the second row. The nodes also multiply in another manner, namely by the transverse division of a single node into two, or to express the fact with greater accuracy, the appearance of two nodes one above the other in the place usually occupied by one. This is seen on the specimens figured, while another example not here illustrated shows the duplication of all the nodes of one row, thus making a complete double row of nodes. This interesting mode of duplication of the nodes has not been observed in any American species, but seems to indicate an approximation to the condition attained in the genus BOTRYODICTYA.

The *reticulum* is very fine, as in *H. Barroisi,* showing none of the coarser meshes prevailing in the Chemung species of this genus. None of the specimens are so preserved as to show tufts at the end of the nodes.

Dimensions. The most complete individual, which bears three horizontal rows of nodes and a considerable portion of an anodose base, has a length of 155 mm. and a width across the top (exaggerated by compression) of 100 mm.

Locality. In the Psammites du Condroz, Jeumont, Brittany.

Rhabdosispongia Condroziana, sp. nov.

Plate xlvii, Figs. 1, 2.

This magnificient species shows some of the exterior characters of the Chemung form, *Dictyophyton Amalthea,* which has elsewhere been taken as the type of the proposed genus Rhabdosispongia. These are, briefly, the successive annulations, separated by deep constrictions and crossed by vertical or divergent ridges.

In the French specimens the apical portion of the cup is regular and without annulations for a considerable distance, the surface here being divided into eight prism-faces. In the best preserved example the first annulation is, on one side, an enormous bulging of the cup, which covers more than one-half the length of the specimen and makes its greatest width. On the other side, this large swelling is divided into two, by a broad constriction near its lower portion, which extends rather more than half-way around the cup. This forms a small annulation beneath and a large one above. The constriction above this double annulation encircles the entire cup, but the succeeding swelling is of less size and is apparently of equal width on both sides of the sponge. Above this is evidence of a still fainter constriction and annulation, making in all four annulations on the best preserved side. There are three specimens of this species in the material at hand, and all of them show the tendency to develop an annulation or swelling on one side earlier than on the other. To this fact are due the slight curvature and lateral asymmetry of the sponge. The eight vertical ridges near the base of the cup maintain themselves over the entire extent of the sponge, diverging greatly as they pass over the expanded portions. Their number is increased by the gradual appearance of new ones at the center of the faces, but the latter are never so strong as the primary ridges.

The *reticulum* is fine-meshed throughout, as in the other species from this horizon.

Dimensions. The largest and best preserved of the three specimens had a length of 300 mm., which must be considerably less than its original length, as parts are lacking at both extremities. Its width at the base is 50 mm., across the first annulation 115 mm., and at the top 100 mm.

Locality. In the Psammites du Condroz, Jeumont, Brittany.

SPECIES OF THE CARBONIFEROUS.

SPECIES OF THE WAVERLY GROUP.

TYLODICTYA, gen. nov.

This generic form is as yet but imperfectly understood. Some recently discovered sponges from Warren, Pennsylvania, present the appearance of erect, reticulated cups, smooth or somewhat irregularly undulated for a considerable part of their length, but abruptly breaking out into one or possibly more whorls of quite unsymmetrical and irregular simple or compound nodes. Apparently there are eight nodes in each whorl, but this is not certain. The nodes are pendulous when large, and in their subdivision have followed no rule or order. The aspect of the cylindrical portions of the sponge is similar to that of the forms of CALATHOSPONGIA with which it is associated, being fine-meshed and free from prismatic faces.

The fragments to which our knowledge of this genus is now restricted, though highly imperfect, are still sufficient to distinguish it from any other.

Type, *Tylodictya Warrenensis*, sp. nov.

TYLODICTYA WARRENENSIS, sp. nov.

Erect, subcylindrical cups, apparently contracting slightly above the base; surface smooth for a considerable distance, then gently expanding and developing a horizontal row of nodes. In the smaller of the fragments which have been observed, these nodes are low, simple, somewhat elongate vertically and divided by narrow furrows which reach to the general surface of the sponge, displaying no tendency to subdivision or irregularity of arrangement; in the larger specimen less of the inferior surface of the cup is retained, but the nodes are very strongly developed, are vertically elongate, and were apparently somewhat fan-shaped, are pendent toward their rounded extremities and separated by grooves of different depth, so that each pair of nodes seems to be elevated on a stout base, as with the nodes in certain species of HYDNOCERAS. Upon one side of this specimen the nodes are much less regular than on the other, one pair having appeared below the others. This pair is divided very unequally by a vertical groove and again horizontally, so that the effect produced is somewhat like that observed among the nodes of BOTRYODICTYA. To what extent

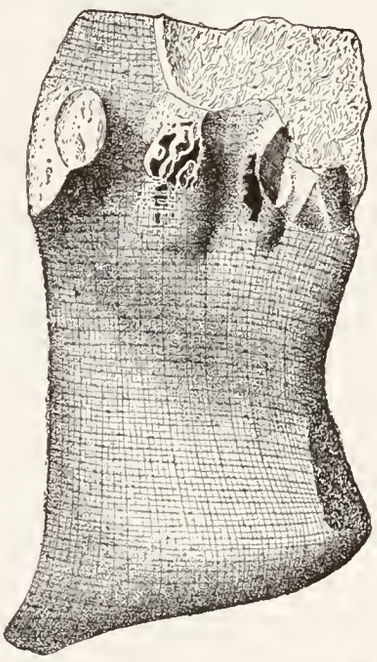
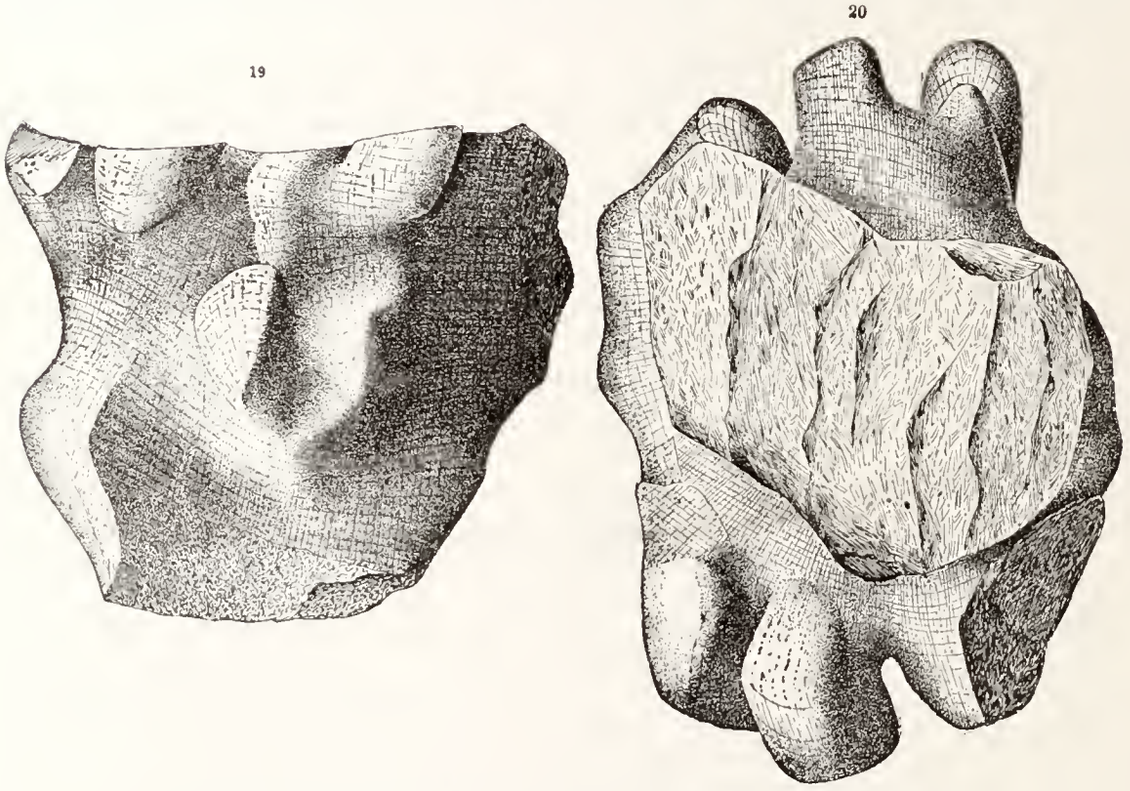


FIGURE 18. *Tylodictya Warrenensis*, Warren, Pennsylvania. A young individual bearing nodes only toward the upper part.

this condition of the nodes is normal and in how far the sponge is affiliated with the last named genus can not at present be determined.

The *reticulum* is very fine-meshed, bearing no conspicuous major divisions, and resembles that of CALATHOSPONGIA.

Of the two specimens referable to this species, one has a length of 75 mm., the lower portion of the cup to the base of the nodes measuring 50 mm. At



FIGURES 19, 20. *Tylodictya Warrenensis*, Waverly sandstone, Warren, Pennsylvania.

Figure 19 gives a side view of the type specimen in which the strong, irregular nodes are much foreshortened. The prominence of these nodes is brought out in figure 20, in which the specimen is viewed from above.

its base this specimen has a width of 45 mm., and its diameter at mid-length is 35 mm. The other fragment is 65 mm. in length and is broken across the expanded nodiferous portion, measuring in diameter to the extremities of the nodes, 90 mm.

Locality. In the Waverly sandstone, Warren, Pennsylvania. (Collection of Prof. C. E. BEECHER.)

TYLODICTYA (?) TENUIS, Hall (sp.).

PLATE LIII, FIGS. 4, 5.

1882. *Dictyophyton tenue*, Hall. Notes on the Family Dictyospongidæ; Expl. pl. 18, fig. 5.

1884. *Dictyophyton tenue*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 474, pl. 18 (19), fig. 5.

The only known specimen of this species is a small fragment of a cup bearing two large, compound nodes separated by a deep longitudinal groove,

and each divided across the top by a low furrow. The nodes are vertically elongated, not constricted at the base, and the lobes are low and obtuse.

The *reticulum* is composed of very fine spicular bands among which scarcely any difference in size is apparent. There is no evidence of a prismatic division of the surface. So few specific characters are retained by this single fragment that it is referred with considerable hesitation to the genus Tylodictya; yet its nodose surface suggests such relationship and its occurrence in the same fauna with *T. Warrenensis* enforces this suggestion.

Locality. In the Waverly sandstone, at Warren, Pennsylvania.

CLATHROSPONGIA, Hall.

(For description see page 121, part 1.)

Clathrospongia abacus, Hall.

Plate xlix, Figs. 5–8.

1882. *Clathrospongia abacus*, Hall. Notes on the Family Dictyospongidæ; Expl. pl. 18, figs. 2–4.

1884 *Dictyophyton* (*Clathrospongia*) *abacus*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 474, pl. 18 (19), figs. 2–4.

Sponge of moderate size, regularly turbinate or obconical; actual base not preserved, but judging from the slope of the sides, acute. Expansion rather rapid. Aperture unknown.

Surface bearing coarse primary spicular ridges, which enclose quadrules measuring on the average 10 mm. in width and 9 mm. in length. These are subdivided into four squares by the secondary spicular bands; the finer divisions of the reticulum may also be preserved. The primary bands are extended into free horizontal and vertical expansions measuring about 8 mm. in width and the deep fenestrations thus made are divided into smaller areoles by the crossing of the subordinate reticulating bands in each; this inference is, at least, to be made from the appearance of finer reticulating lines on the surface of the primary expansions.

Dimensions. Length of the original specimen, 100 mm.; greatest diameter of the cup (at upper extremity), 50 mm.; median diameter, 38 mm. without, and 54 mm. with the lamellar expansions.

Locality In the sandstones of the Waverly group, associated with *Ectenodictya implexa*, and an undetermined *Spirifer* or *Syringothyris;* Warren, Pennsylvania.

CLATHROSPONGIA CAPRODONTA, sp. nov.

PLATE L, FIGS. 8, 9.

SPONGE slender, elongate obconical, gradually enlarging from an acute base to the aperture, the rate of expansion being the most rapid over the earliest one-third of the length. Surface faintly subprismatic, with low nodes at the intersection of the primary spicular bands.

Upon the single specimen observed, which is an internal cast, the reticulum shows twelve longitudinal spicular ridges which, with the intersecting horizontal ridges of about the same size, form large primary quadrules. Over the body of the cup these measure about 13 mm. in width and 19 mm. in length, making a comparatively large quadrule which was evidently very sharply defined over the entire cup, except at the base and about the aperture. The angles of these quadrules bear pronounced nodes, not so highly developed as in HYDNOCERAS, but indicating a tufted projection of the spicules, undoubtedly accompanied by a strong lamellar spicular band along the primary vertical and horizontal ridges. These ridges and nodes are somewhat obscured by the secondary reticulation, the entire surface being covered with meshes measuring about 2 mm. on a side, the intermediate reticulation being virtually lost.

The cup has an entire length of 185 mm. and an apertural diameter of 63 mm. Its diameter at 50 mm. from the apex, is 38 mm., and at 125 mm. from the base, it is 57 mm.

Locality. In the sandstone of the Waverly group, at Portsmouth, Ohio. (Collection of the School of Mines, Columbia University, New York.)

THYSANODICTYA, gen. nov.

(For description see page 125.)

THYSANODICTYA EXPANSA, Hall (sp.).

PLATE LIII, FIG. 3.

1882. *Phragmodictya expansa*, Hall Notes on the Family Dictyospongidæ; Expl. pl. 19, fig. 10.

1884. *Ectenodictya expansa*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 475, pl. (19) 20, fig. 10.

The original specimen of *Ectenodictya expansa* is a portion of a very large basal disc or diaphragm, representing a species of those forms occurring abundantly in the Chemung sandstones for which we have erected the genus THYSANODICTYA. The species is somewhat irregularly nodose over the surface

and quite strongly so at the margins, the elevations there being elongated and extended for some distance over the basal surface; presenting an aspect similar to this part of the cup in *Th. Edwin-Halli* and *Th. rudis*, of the Chemung group.

The *reticulum* is irregular, as in all of these basal disks which have been subjected to compression, but at certain spots a strong reticulation is retained, composed of major quadrules measuring about 6 mm. on a side, subdivided by two or three series of subordinate bands. The primary ridges are elevated and indicate a strong and coarse net-work over the lateral walls of the cup.

The diameter of this disc is 150 mm., a size which is not attained by specimens of any other species of the genus.

Locality. In the sandstone of the Waverly group, Warren, Pennsylvania.

CALATHOSPONGIA, gen. nov.

1863. *Dictyophyton*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 88.

1882. *Phragmodictya ?*, Hall. Notes on the Family Dictyospongidæ; Expl. pl. 17, fig. 9.

1884. *Dictyophyton ?*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 474.

Stout, subcylindrical cups, with truncated bases, without basal cone or diaphragm as far as known, but probably attached by the basal margins; contracted medially and more or less expanded at the aperture. Surface without nodes or other ornament.

Type, *Dictyophyton Redfieldi*, Hall.

Calathiospongia Redfieldi, Hall (sp.).

Plate xlviii, Figs. 1, 2; Plate xlix, Figs. 1–4.

1863. *Dictyophyton Redfieldi*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 88, pl. v, fig. 1; pl. v a, fig. 1.

1882. *Phragmodictya ? Redfieldi*, Hall. Notes on the Family Dictyospongidæ; Expl. pl. 17, fig. 9.

1884. *Dictyophyton ? Redfieldi*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 474, pl. (17) 18, fig. 9.

1889. *Dictyophytum Redfieldi*, Lesley. Dictionary of Fossils, p. 200.

Sponge large, probably subcircular in cross-section; base broad, expanded at the margin; the basal expansion continues for about one-third the length of

the cup, passing upward into a long, shallow constriction; the apertural part of the cup is again gradually expanded, the greatest diameter being at the aperture, which is unconstricted. The normal form of the sponge as thus described, is best represented by the example shown upon Plate xlix, (figs. 2 and 3) which is essentially entire. The skeleton of this species was evidently very delicate and fragile, as larger specimens are all more or less broken and distorted. Surface quite smooth.

Reticulum composed of fine and minute quadrules. Very faint longitudinal ridges are visible in places, especially upon one side of the largest observed example, but these can be discerned only over the apertural part of the cup. The more noticeable spicular bands are the horizontal ones which succeed each other at pretty regular intervals of from 3–4 mm. The vertical bands corresponding with these are rarely well preserved, so that the usual aspect of the surface is a succession of narrow horizontal bands. The quadrules formed by the horizontal bands and their corresponding vertical bands are subdivided by four subordinate series of spicules, so that the ultimate division of the surface, which is usually sharply retained, is very minute. Upon certain portions of any given specimen, the coarser reticulation may be wholly lost, leaving traces of only the finer division of the reticulum. The apertural margin is regular and entire.

Dimensions. A small, but entire and slightly compressed example has a length of 70 mm.; it measures 32 mm. in diameter at the base; 30 mm. just above the base, and 33 mm. at a distance of 10 mm. above the base; at the middle of the cup its diameter is 25 mm., and at the aperture, 51 mm. A large example has been somewhat shortened by vertical compression which has produced an abnormal swelling about the middle of the cup. Its length is 183 mm.; its basal diameter about 96 mm.; at a point slightly above the middle, 72 mm.; and at the aperture, 135 mm. The original specimen has a length of 200 mm.; a basal width of 86 mm.; a median width of 38 mm., the upper part of the cup, which is somewhat distorted, being 105 mm. in diameter.

Localities. The specimen upon which the original description of the species was based was collected near Harrisville, Medina county, Ohio, in a yellowish sandstone of the Waverly group, by the late W. C. REDFIELD. It has also been found in the Cuyahoga shale of the Waverly group, at Akron, and at Richfield, Ohio, and also in the Waverly sandstone on Nelson's farm near Pleasantville, Venango county, Pennsylvania.

Calathospongia carceralis, sp. nov.

Plate li, Figs. 2–4; Plate lii, Figs. 2, 3; Plate lx, Figs. 1, 2.

1863. *Dictyophyton Newberryi*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., pl. iv, fig. 3.

Among the specimens utilized for the original illustration of the species *Dictyophyton Newberryi*, was one large subcylindrical cup which was doubtfully regarded as representing the pedicel of that species. A re-examination of this specimen, supplemented by other material, some of which has been collected since the date of that description, shows very clearly that such specimens represent a quite distinct form of sponge.

Cup elongate, rather stout, probably circular in cross-section, though all the specimens are more or less flattened. Base broad, terminating abruptly; from the base upward the body contracts slowly and then very gradually expands to the aperture. The form is thus somewhat like that in certain species of Thysanodictya (e. g. *Th. pœcilus*) but the truncated base affords no evidence of a diaphragm or any other method of closure.

The *reticulum* is characterized by strong vertical and horizontal primary ridges, the former being the more conspicuous and in some instances so highly developed as to give a subprismatic appearance to the cup. In the specimens from the Waverly sandstones these vertical ridges are twelve in number and their intersection with the principal horizontal ridges forms quadrules measuring about 8 mm. in width and 12 mm. in height; the development of the horizontal spicular ridges is, however, quite variable. The subordinate reticulation is sharply developed. The apertural margin is regular and the primary reticulation extends to it without material loss of definition.

Dimensions. The original example which is essentially entire, has a length of 145 mm.; a width at the base of 33 mm.; at 40 mm. above the base the diameter increases to 46 mm.; decreases above to 43 mm.; and expands to the aperture which is 65 mm. in width. This specimen is from the Waverly group. An entire specimen from the Keokuk group is 130 mm. in length; 48 mm. in diameter at the base; 75 mm. at the aperture, and 40 mm. where narrowest.

Localities. In the shales and sandstones of the Waverly group at Richfield Ohio; also in the calcareous shales of the Keokuk group at Indian Creek, Indiana. (The latter from the collection of A. S. Tiffany.)

CALATHOSPONGIA CARLLI, sp. nov.

PLATE LII, FIGS. 4–7.

Among some specimens of Dictyosponges from the Waverly group of northern Venango county, Pennsylvania, kindly loaned for study by Mr. JOHN F. CARLL, formerly of the Second Geological Survey of that state, is one rather large specimen of the upper portion of the cup which in the aspect of the surface, bears no little similarity to *C. Redfieldi* but it has a proportionally much broader aperture than is possessed by that species. The specimen has been somewhat compressed obliquely, but apparently without serious distortion to the best exposed surface. The body of the cup is moderately narrow, measuring 55 mm.; the width of the aperture is 145 mm., but this is perhaps somewhat below its original proportions as the apertural portion of the cup has been slightly enfolded on one side.

The character of the *reticulum* is essentially the same as that of *C. Redfieldi*, the surface being crossed transversely by numerous strong spicular bands, while the vertical bands are very fine and all trace of conspicuous vertical ridges is wanted.

Localities. In the sandstones of the Waverly group. "Found loose on the flats of Oil Creek, near the mouth of Pine Creek. The stream here cuts down about 15 feet below the Berea grit" (Mr. CARLL's letter); near Pleasantville, Venango county, Pennsylvania. The species also occurs in the same rocks at Warren, Pennsylvania, and some of the specimens from there, like that shown in figure 21, page 159, indicate the probable identity of *C. Carlli* with the fragmentary remains described as *Ectenodictya implexa*.

CALATHOSPONGIA TIFFANYI, sp. nov.

PLATE LI, FIGS. 5, 6.

SPONGE subcylindrical toward the base, expanding with moderate rapidity to the aperture, producing an elongate, subconical vase-shape. Surface with obscure traces of prismatic faces which widen upward. Where best preserved these faces are seen to be marked by moderately strong spicular ridges crossed by less prominent bands, the two making quadrules measuring approximately 12x10 mm. where the faces are least expanded, but increasing in width, without increase of length, toward the aperture. The intersections of these primary bands are obscurely nodose. The subdivision of the quadrules to the fifth degree is very clearly seen on the internal cast. The surface is otherwise devoid of ornamentation.

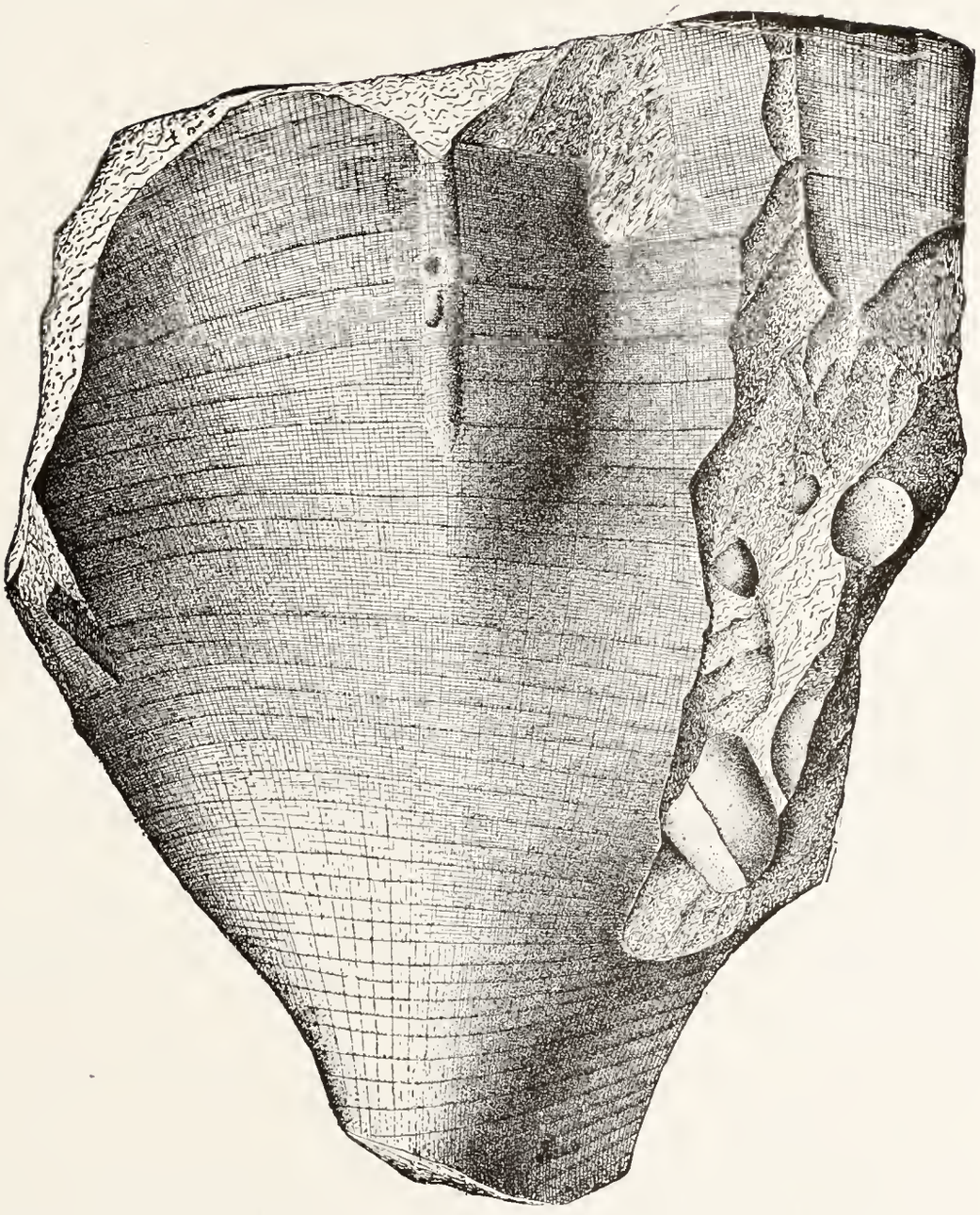


FIGURE 21. Portion of a large specimen of *Calathospongia Carlli*, from the Waverly sandstone at Warren, Pennsylvania.

The type specimen, which is imperfect toward the base, has somewhat the aspect of *C. carceralis* and evinces a probable agreement in form with the other species of the genus CALATHOSPONGIA. Its condition of preservation is not such as to show with certainty specific differences from *C. carceralis* except in its stouter form and more rapid apertural expansion

Dimensions. Length (incomplete) 100 mm.; apertural diameter (slightly flattened) 84 mm.; diameter at lower extremity, 39 mm.

Locality. Waverly group, Ohio. (Loaned by A. S. TIFFANY.)

CALATHOSPONGIA ? SACCULUS, Hall (sp.).

PLATE L, FIG. 7.

1863. *Dictyophyton Redfieldi*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., pl. iv., fig. 6.

1884. *Dictyophyton sacculum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 473.

The specimen upon which this species (?) was founded is a small, short, apparently subcylindrical cup, with a smooth surface and very fine reticulum. One extremity is rather irregular and apparently incomplete, while the other seems to be closed or enfolded. There is very slight, if any, increase in diameter from one end to the other. It seems probable that the specimen is incomplete and affords no precise conception of its original form. The reticulation is somewhat similar to that of *Calathospongia Redfieldi*, but lacks the strong horizontal bands of that species. Its recognition as a species and its reference to this genus are only provisional.

The length of the specimen is 33 mm.; its width about 18 mm.

Locality. In the shaly sandstone of the Waverly group at Richfield, Ohio.

THAMNODICTYA, Hall.

1863. *Dictyophyton*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 87.

1882. *Phragmodictya*, Hall. Note on the Family Dictyospongidæ; Expl. pl. 17, figs. 10, 11.

1884. *Thamnodictya*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 466, 477.

Dictyosponges with a narrow, subcylindrical, tubular stem below, abruptly widening above into a broad funnel-shaped circular cup. Surface with prominent spicular ridges, but without nodes or well defined prism-faces.

Type, *Thamnodictya Newberryi*, Hall.

In the observations made upon the genus Hydnoceras, reasons have been given for discontinuing the generic term Dictyophyton. It is not necessary to recount these further than to recall that the term was introduced, not primarily to replace Conrad's name Hydnoceras, but as a designation for other, and anodose species, the first among the specified types being *Dictyophyton Newberryi*, the form subsequently adopted as the type of Thamnodictya. Dictyophyton has proved to be a misleading term among the sponges, and its place is better filled by the various generic terms which the requirements of our present knowledge have originated.

Thamnodictya Newberryi, Hall.

Plate l, Figs. 1–6; Plate lii, Fig. 1.

1863. *Dictyophyton Newberryi*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 87, pl. iv, figs. 1, 2, 4, (not fig. 3).

1882. *Phragmodictya Newberryi*, Hall. Notes on the Family Dictyospongidæ; Expl. pl. 17, figs. 10, 11.

1884. *Thamnodictya Newberryi*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat., Hist., p. 477 (partim) pl. (17) 18, figs. 10, 11.

Sponge of moderate size, attenuate and subcylindrical toward the base, rapidly expanding above, forming a broad vase supported upon a long pedicel. Cross-section at any point of the vase circular; the pedicel however appears to have been obscurely prismatic.

Reticulum composed of strong rectangularly intersecting bands, the primary series being broad and forming trapezoidal quadrules, averaging, over the main portion of the vase, about 6 mm. in diameter and 9 mm. in height. The vertical strands diverge very rapidly outward with the growth of the cup, losing their conspicuous size toward the aperture. The subordinate net-work is sharp and fine, especially in the apertural region where the prevalence of the finer strands obliterates the coarser meshes. The pedicel, which is not well preserved in any of the specimens studied, appears to have borne coarse vertical ridges toward its upper part.

Dimensions. The original example of this species is the most complete in the collections examined. Its length from the lower end of the pedicel, which appears to be nearly complete, to the aperture, is 115 mm.; the median width of the pedicel, 7 mm.; the diameter of the aperture, 90 mm. Portions of

other specimens of about the same size have been observed, but the majority of these are of small size.

Under this specific name we have included only the slender forms possessing the expanded aperture. In previous descriptions some much larger subcylindrical bodies have been regarded as pedicels of the same species, but their size and general aspect, supplemented by some additional structural details, indicate that these latter forms are quite distinct from typical examples of THAMNODICTYA.

Localities. In the beds of the Waverly group. The original example, that shown on Plate 1, fig. 1, is from a shaly limestone filled with *Fenestella* and *Productus*, at Richfield, Ohio. Other specimens are from sandy shales and limestones at Cuyahoga Falls, Ohio.

THAMNODICTYA ORTONI, sp. nov.

PLATE LIII, FIGS. 1, 2.

This species is represented by an internal cast, in a compact ferruginous sandstone, of the upper or vase-shaped portion of a THAMNODICTYA. It is a large, somewhat compressed individual preserving a considerable portion of the aperture. At its lower point, which represents the opening of the pedicel, the surface shows several somewhat unequal clusters of the longitudinal spicules which have been changed to limonite. The impression of the reticulum is fine and rather irregular. There are no predominant vertical and horizontal spicular ridges as in *Thamnodictya Newberryi*, but the entire surface is covered by small quadrules about 2 mm. square and these are again divided by minute subordinate bands. The course of the vertical bands is not radial from the base, but they appear to have made a broad simple curve in extending toward the aperture, a feature which may be exaggerated by the compression of the specimen. Along the apertural margin the net-work is much finer than elsewhere.

The specimen measures from base to aperture, on one side, 80 mm. and on the other, 97 mm.. Its greatest diameter is from one edge of the folded apertural margin to the other; each of these lateral extremities is somewhat broken but the full measurement was about 150 mm. The lower sides of the cup slope at an angle of about 60 degrees.

Locality. In the Cuyahoga shale of the Waverly group, Moot's run, Licking county, Ohio. (Named for Dr. EDWARD ORTON, of Columbus, Ohio.)

CLEODICTYA, Hall.

1884. *Cleodictya*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 467, 479.

Vase-shaped Dictyosponges, broadly expanded near the base into a single horizontal row of strong low nodes, thence gradually contracted and again widening to a broad aperture. Surface without evidence of prismatic faces or projecting spicular lamellae.

Type, *Cleodictya gloriosa*, Hall. Keokuk group.

Cleodictya Claypolei, sp. nov.

Plate li, Fig. 1.

Sponge comparatively small, subturbinate, expanding rather rapidly from the basal extremity into a single horizontal row of nodes which begin a short distance above the base and extend through fully one-third the length of the cup. These nodes, though some are lost on one side of the sponge, appear to have been eight in number, and were low and elongate, their length measuring twice their width; they are separated by narrow furrows which do not extend down to the unswollen surface of the sponge. Above these nodes the surface is abruptly constricted and thence widens very gradually upward, the apertural margin not being retained. The proportions of this species are different from those of *C. gloriosa*, the form being more slender, the expansion more gradual and the basal nodes much more elongate.

The *reticulum* is very fine and the primary divisions somewhat obscured. A series of transverse bands 3–4 mm. apart, crosses the cup, without vertical bands of corresponding strength. This gives to the reticulum the aspect of that in *Calathospongia Redfieldi* and *C. Carlli*. Minor subdivisions to the fifth series are discernible.

Dimensions. The specimen described is somewhat imperfect at both extremities; it does not, however, seem probable that much has been lost from either. The entire length of the portion retained is 102 mm. Its basal extremity has a diameter of 25 mm.; across the row of nodes the diameter is 70 mm.; just above these nodes it is 45 mm. and at the upper extremity, 50 mm.

Locality. From the sandstones of the Waverly group at Akron, Ohio. (Received from Prof. E. W Claypole.)

(?) ECTENODICTYA, Hall.

1884. *Ectenodictya*, Hall (partim). Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 466.

The name ECTENODICTYA was introduced for certain forms of apparently more or less irregular growth, which seemed to have expanding or unenclosed fronds. Both in the upper Devonian and the lower Carboniferous faunas sponges of such aspect have been found, with a surface usually free of nodes or other ornamental characters. The absence of a well defined form in these species was the principal reason for placing them together under a single generic term, although the division could, by the very nature of its composition, have little more than a temporary value. In 1884, two species, *E. implexa* and *E. expansa* were described from the Waverly sandstone, *E. Burlingtonensis* from the Burlington group and *E. eccentrica* from the Keokuk group. Fossils of like character are also abundantly known in the Chemung group but no names have been applied to them. The accession of material has shown that such Chemung specimens indicate, by one or another set of characters, relations to some of the larger sponges of the group, many of these imperfect fronds probably representing the species *Prismodictya choanea, D. Almondensis,* or some similar sponge in which the expanse of surface is large and the prismatic aspect obscured. Thus, also, with most of the described species of ECTENODICTYA; *E. Burlingtonensis* seems a probable representative of the genus LYRODICTYA; *E. expansa* undoubtedly represents a species of THYSANODICTYA and *E. eccentrica**, as now known, is the basal diaphragm of a sponge like PHRAGMODICTYA, but having a structure necessitating its removal to another and new genus, ACLEODICTYA. There remains, then, but the type-species of ECTENODICTYA, *E. implexa*, whose apparent structure is here described.

ECTENODICTYA IMPLEXA, Hall.

PLATE LIV, FIGS. 3, 4.

1884. *Ectenodictya implexa*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 475, pl. (18) 19, fig. 1.

"Frond a reticulate expansion, assuming a variety of form from pressure or other causes; the original form has been apparently broadly funnel-shaped or ovoid. Base unknown.

* These species were first described as PHRAGMODICTYA.

"Surface cancellate by strong concentric and vertical striae; the intermediate spaces finely reticulate by filiform striae, which cross each other rectangularly. The body presents prominences or protuberances, which are not sufficiently elevated to be termed nodes.

"A large imperfect specimen, which is distorted by compression, has a length of 180 mm. and a width of about 93 mm.

"The specimens of this species are all more or less distorted; they appear as broad funnel-shaped expansions without evidence of a distinct tubular base, and are usually fragmentary".

The foregoing is the original description of these fossils, founded upon very imperfect material. Upon re-examination of these specimens and comparison with the more completely known species from the Waverly group of Pennsylvania we are disposed to conclude that all are fragments of *Calathospongia Redfieldi* or its close ally, *C. Carlli.* It has already been observed that the cups of these species were very delicate and fragile, easily liable to distortion and fracture; and there are none of the specimens upon which the description of *Ectenodictya implexa* was based which do not show the characteristic expression of the reticulum produced by the predominance of the horizontal spicular bands. The specimen from which the original illustration was drawn, is the apertural portion of a large cup somewhat infolded at the margin. It was incorrectly oriented in the drawing; the right margin represents the apertural edge.

Localities. The specimens have been found in the Waverly group at Warren, Pennsylvania, in association with *Syringothyris Randalli,* and in the same formation at Oil City, in that state.

SPECIES OF THE BURLINGTON GROUP.

LYRODICTYA, Hall.

(For description see page 170.)

Lyrodictya (?) Burlingtonensis, Hall (sp.).

Plate liii, Fig. 6.

1884. *Ectenodictya Burlingtonensis,* Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 476.

The single specimen representing the only species of Dictyosponge yet found in this formation, consists of a quite imperfect outer impression of a cyathiform frond, having a smooth exterior and showing a strong development

of the vertical spicular bundles toward the base and extending upward in one or two broad and irregular strands. The *reticulum* is fine-meshed and over most of the surface the prevailing quadrule has a diameter of about 3 mm., being frequently subdivided by subordinate series of spicules. The general aspect of the specimen is like that of LYRODICTYA, and the species is therefore provisionally referred to this genus.

Dimensions. Length of the fragment 135 mm., greatest width 130 mm.

Locality. In the yellow sandstone below the Burlington limestone, Burlington, Iowa.

SPECIES OF THE KEOKUK GROUP.

DICTYOSPONGIA, gen. nov.

(For description see page 72, part 1.)

DICTYOSPONGIA CYLINDRICA, Whitfield (sp.).

PLATE LV, FIG. 3; PLATE LXI, FIG. 6.

1881. *Dictyophyton cylindricum*, Whitfield. Bull. No. 1, Amer. Mus. Nat. Hist., p. 19, pl. iv, fig. 3.

1884. *Dictyophyton cylindricum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 475.

The original specimen of this species is a fragment of a flattened subcylindrical or elongate obconical tube, exposing, for the most part, the inner portions of the reticulum but also showing that the exterior of the sponge was devoid of ornamental features. The exposed surface exhibits fine smooth horizontal and vertical spicular rods disposed at numerous and somewhat unequal intervals in small bundles. The outer or dermal quadrules are formed by cruciform spicules, and measure about .5 mm. on each side. Microscopic examinations of the reticulum reveal among the parenchymalia or dermalia, umbels of a form somewhat different from those in CLEODICTYA, curved diactins and fragments of minute echinate hexactins.

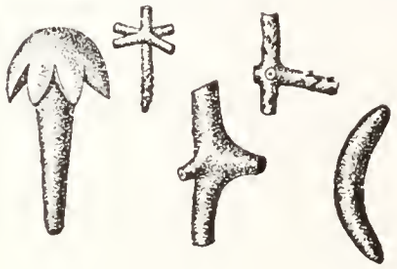


FIGURE 22. Spicules of *Dictyospongia cylindrica*, x400. (J. M. C.)

This species seems to be of rare occurrence; besides the original specimen, there are, in the material in hand, only one or two small fragments, so that the species is still quite imperfectly known. The typical example has a length of 60 mm. and a width of 56 mm.

Locality. In the calcareous shales at Crawfordsville, Indiana.

Dictyospongia (?) stylina, sp. nov.

Plate lvi, Fig. 2.

Among the material from Crawfordsville is a slender elongate fossil whose sponge nature is strongly suggested by a comparison with the graceful Chemung species, *Dictyospongia lophura*. It is therefore noticed here, although its precise relations may still be somewhat obscure.

The fossil is narrow and subcylindrical, expanding from the basal point to the full diameter of the cup in about one-eighth the length of the specimen. The surface is smooth and covered with fine, closely set vertical lines. The evidence of transverse lines is not very satisfactory; there is, however, a series of comparatively broad and low transverse depressions which are plainly developed over the upper part of the specimen, and these contract toward the upper extremity, producing, with the vertical lines, the effect of an elongate rectangular reticulation. Below this extremity the transverse depressions produce a somewhat undulating surface.

The specimen has a length of 91 mm. and a diameter of about 6 mm. for seven-eighths of its length. There is no evidence of a spicular tuft at the basal extremity.

Locality. In the calcareous shales at Crawfordsville, Indiana.

Dictyospongia (Mastodictya) osculata, sp. nov.

Plate lvi, Fig. 6.

The figure cited represents one aspect of a sponge of whose complete form it is not possible to obtain an accurate conception from the material in hand. If the peculiar shape presented by it is normal or essentially so, as it seems to be, then this species represents a distinct type of generic structure which, if established by future investigations, may be known as Mastodictya; but it is still possible that the shape of the sponge is more or less due to compression or other casual cause. Hence the characters of the fossil are here described from the single example known, while its generic and specific values are left contingent upon the discovery of additional material.

The lower, broken extremity of the specimen has a width of 20 mm. and thence it gradually widens upward into the bulbous swellings. Here the diameter of the cup has increased to 24 mm. The swelling at the right contracts quite abruptly and apparently terminates in an osculum or excurrent orifice at 7 mm. above its greatest diameter; the portion on the left however is much more produced, contracts more gradually, extends to a distance of 23 mm. above the swelling and at the aperture has a diameter of 4 mm.

The general surface is smooth, gracefully expanding to the bulbous swellings, thence sloping with gentle concavity to the oscula.

The *reticulum* is fine-meshed. Since only the outer portion is exposed, the vertical spicular bundles are not visible, but a fragment of a very large rod is seen in the accompanying figure. At the angles of the prevailing quad-

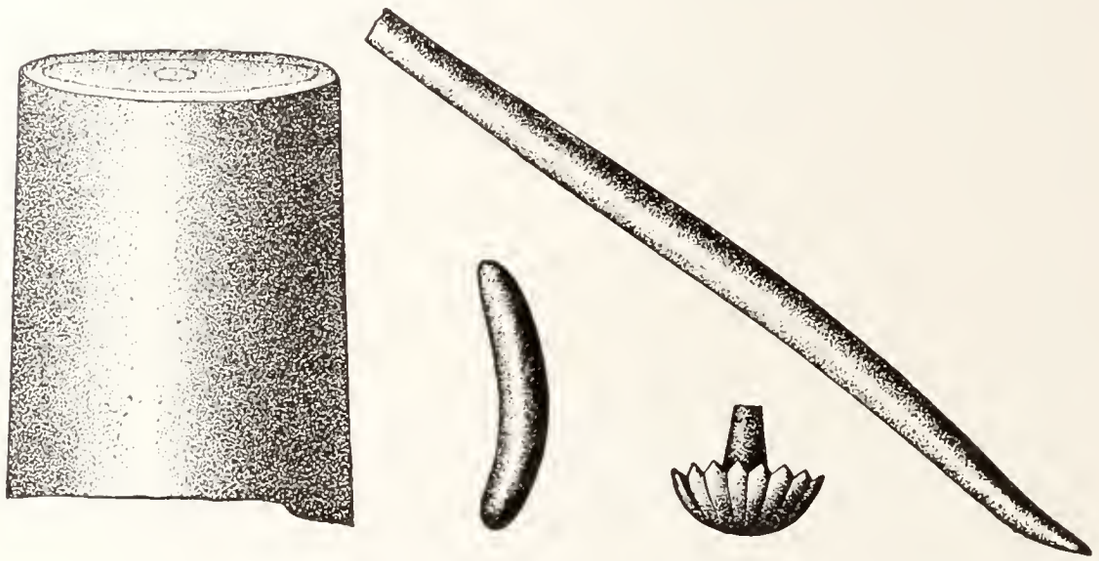


FIGURE 23. Spicules of *Mastodictya osculata*, ×400. (J. M. C.)

rules, which measure about 1.5 mm. on a side, there are very strong pentactins or hexactins with modified outer arm, and lateral arms extending for nearly the entire length of the quadrule. An extremital fragment of one of these is represented in the above figure which also shows a many-toothed umbel and a siliquiform diactin.

Locality. In the calcareous shales at Crawfordsville, Indiana.

PRISMODICTYA, gen. nov.

(For description see page 79, part 1.)

PRISMODICTYA POLYHEDRA, sp. nov.

PLATE LV, FIGS. 1, 2.

SPONGE large, subcylindrical, obscurely polyhedral, slightly expanding toward the top. Surface regular and uniformly free of asperities, nodes or protuberances except such as are produced by the slight outward extension of the principal spicular bundles. In the best preserved of the compressed specimens each side bears five broad vertical faces, and at the edges are traces of two more, twelve in all. These prism-faces make low angles with one another, becoming obsolete at the even and regular margin of the osculum.

Reticulum. The quadrate meshes are remarkably uniform in size and arrangement. Assuming that the vertical spicular bands of the first order lie along the angles made by adjoining prismatic faces, a given square of the first order measures about 20 mm. on a side, varying with the slight curvature of the surface, and with the upward expansion of the prism-faces. The subdivision of these quadrules is carried out with regularity to the fifth degree, and even in some of these pentameres there is evidence of a division into ultimate quadrules. Some of the specimens indicate that the surface, in its original condition, was fenestrated by the slight projection of the principal lamellae.

Dimensions. The apertural width of the specimen figured is 120 mm.; its diameter where narrowest is about 90 mm. and the incomplete cup has a length of 115 mm. which was probably somewhat more than one-half its entire length.

Locality. In the calcareous shales at Crawfordsville, Indiana.

LEBEDICTYA, gen. nov.

Large obconical cups, perhaps somewhat unsymmetrical by reason of more rapid growth on one side, probably expanding from a subacute base. Surface obscurely prismatic and cancellated by short projecting spicular lamellae. Aperture crowned by an erect fringe of long marginal spicules.

Type, *Lebedictya crinita*, sp. nov.

Lebedictya crinita, sp. nov.

Plate lviii, Figs. 1, 2; Plate lix, Figs. 1, 2; Plate lxi, Fig. 5.

Sponge cyathiform, expanding with apparently slight asymmetry from a narrow base. This asymmetrical growth is especially evident in one specimen which not only shows a notable difference in the size of the two sides, but along the apertural margin, which is distinctly retained, indicates a rapid multiplication of the spicular net-work on the longer side of the cup. The surface is rendered obscurely prismatic by the predominance of certain vertical skeletal ridges which, near the aperture, lie about 25 mm. apart. The horizontal ridges do not attain so great size, but the prevailing quadrules are nevertheless large, measuring from 12 to 15 mm. on a side, and are variously subdivided. All these vertical and horizontal spicular bands are erect and form a moderately deep surface reticulation. There may also have been minute tufts at the intersections but the evidence of them is not very clear. The fenestration of the exterior of the cup is similar to, but much less

decided than that in the genus CLATHROSPONGIA, and upon internal casts is much obscured or even lost.

About the aperture the vertical spicules are extended into a long and narrow marginal tuft, apparently a single row of coarse and fine rods (*marginalia*), such as occurs in the living species *Bathydorus fimbriatus*.*

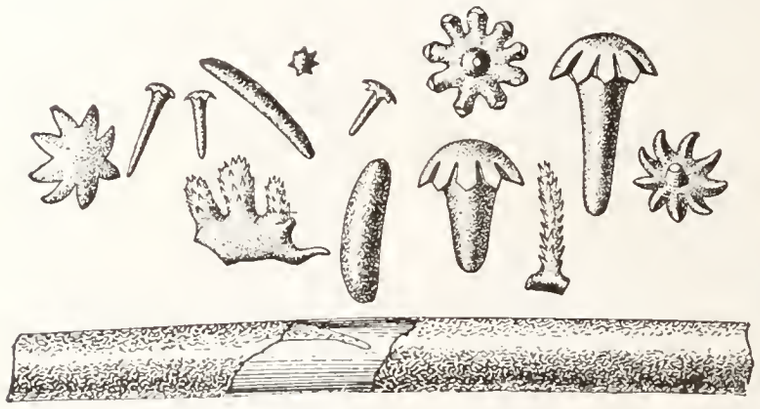


FIGURE 24. Spicules of *Lebedictya crinita*, x400.

The figure at the bottom is a fragment of one of the main rods, partly decorticated; among the others are umbels and micrumbels in various attitudes, smooth diactins, an incomplete tripinulus, etc. (J. M. C.)

In figure 24 are shown some of the skeletal elements of this sponge, the dermalia being represented by umbels, micrumbels, tripinulus and echinate pentactins, and the parenchymalia by smooth siliquiform diactins.

Dimensions. The best preserved specimen, which is incomplete at the lower end, has a length from aperture downward of 155 mm. Its lower diameter is 75 mm.; its apertural diameter in its compressed condition 150 mm. The marginal fringe in some places has a length of 30 mm. A somewhat larger specimen which has been compressed almost vertically has an apertural diameter of 180 mm.

Locality. In the shales of the Keokuk group at Crawfordsville, Indiana. (Collection of A. S. TIFFANY.)

LYRODICTYA, Hall.

Cyathiform Dictyosponges with regularly expanding, generally smooth exterior, fine net-work, low, erect tufts at wide intervals and very broad, thick vertical bundles of rods and clemes, with no horizontal bundles of corresponding size.

Type, *Lyrodictya Romingeri*, Hall.

LYRODICTYA ROMINGERI, Hall.

PLATE LVI, FIG. 1.

1884. *Lyrodictya Romingeri*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 476.

SPONGE broadly expanding; its form imperfectly known. Surface probably covered originally with low and erect lamellae; ridges with short tufts at

*See SCHULZE, Hexactinellida, pl. lviii, fig. 1.

the angles of some of the quadrules; but in its general aspect smooth, without prism-faces, nodes, or other irregularities.

Reticulum characterized by very broad and strong vertical bundles or *lateralia*. On the exposed surface of the specimen there are seven of these at wide but unequal intervals. These bundles reach almost or quite to the lower extremity of the specimen, spreading gradually outward. An interesting structural feature is the intercalation of other bundles in two of the interspaces at a considerable distance above the base, and both these and the primary bundles increase in width upward. All the bundles are composed of a large number of stout, cylindrical, continuous rods, varying somewhat in size, and with them are numerous clemes of so great size as to be visible to the naked eye. The latter appear to be restricted to the middle and upper extent of the bundles, no trace of them having been found on the lower part of the specimen, and on some of the intercalary bundles they are not to be seen at all. These clemes are similar to those occurring in *Physospongia Dawsoni* and *P. Colleti*, though very much larger. The direction of their teeth is, however, directly the reverse of that in all other known instances. This peculiar fact at first suggested the possibility of an error in the orientation of some of the specimens but repeated reviews of our observations seem to dispel any doubt of their accuracy.

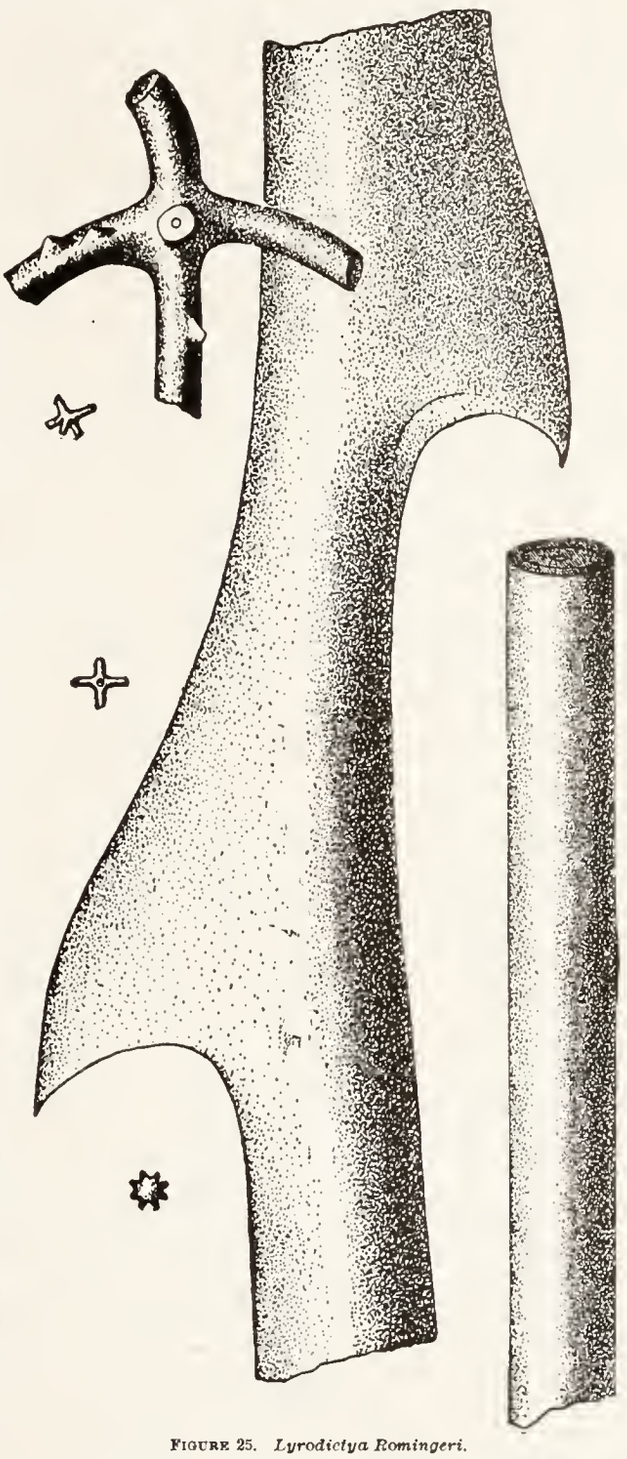


Figure 25. *Lyrodictya Romingeri.*

Fragment of one of the large reversed clemes, a diactine rod, cruciform spicules of various sizes and the upper surface of a very small umbel. ×400. (J. M. C.)

There are no horizontal bands corresponding with these vertical bundles The rest of the skeleton is pretty much lost; here and there a few interlacing horizontal spicules are to be found at the intersections, but the broad vertical interspaces are regularly divided by impressions of small quadrules which measure from 2 to 3 mm. on a side, without further evidence of coarser markings. At one side of the specimen the edge of the cup is exposed and shows the fact that the interstitial vertical and cross spicules projected for a short distance beyond the surface of the cup, and also that at wide intervals there were small projecting tufts similar to those in PHYSOSPONGIA.

In the matrix taken from the interspaces between the lateralia have been found large echinate hexactins or pentactins with curved arms, also some minute hexactins and microrhabds.

Dimensions. The single known specimen of this species has a length of 98 mm. and a maximum width of 105 mm.

Locality. In the calcareous shales of the Keokuk group, Crawfordsville, Indiana.

PHRAGMODICTYA, Hall.

1881. *Dictyophyton*, Whitfield. Bull. No. 1, Amer. Mus. Nat. Hist., p. 18.

1882. *Phragmodictya*, Hall. Notes on the Family Dictyospongidæ; Expl pls. 17, 19, 20.

1884. *Phragmodictya*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 466, 477, 478.

Sub-cylindrical or slightly expanding cups abruptly contracted at the base to form a smooth, broadly obconical or nearly transverse plate or diaphragm. The edge of this basal plate bears a broad peripheral frill. Attachment was probably effected both at the apex of the diaphragm and by the basal frill. Surface covered with vertical ridges and nodes. Reticulum very fine and without tufts.

Type, *Phragmodictya catilliformis*, Whitfield (sp.).

This genus differs from THYSANODICTYA in the absence of a coarse regular quadration and fenestration of the surface and in the distinctly radiate network of the basal diaphragm, and from ACLŒODICTYA in the convergence of the radial bands of the diaphragm to a well-defined and probably tufted apex.

Phragmodictya catilliformis, Whitfield (sp.).

Plate lxiv, Figs. 1–5; Plate lxv, Figs. 1, 2; Plate lxvi, Figs. 1–9; Plate lxvii, Figs. 1–4; Plate lxviii, Figs. 1–4.

1881. *Dictyophyton catilliforme*, Whitfield. Bull. No. 1, Amer. Mus. Nat. Hist., p. 18, pl. iii, fig. 1.

1882. *Phragmodictya scyphus*, Hall. Notes on the Family Dictyospongidæ. Expl. pl. 17, figs. 12, 13; pl. 19, figs. 2, 3; pl. 20, figs. 1–6.

1884. *Phragmodictya catilliformis*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 477, pl. 18, figs. 12–14; pl. 20, figs. 2, 3; pl. 21, figs. 1–6.

Sponge sometimes of large size but usually of medium proportions; subcylindrical or with a somewhat flaring aperture; base broad, slightly expanded, its diameter increased by the projection of the periloph. General form stout, the length being less than twice the median diameter. Specimens having the aperture clearly retained show a slight contraction of the upper margin but it is not fully determined whether this is a normal feature.

The base is a very shallow obcone with a slightly eccentric apex; its margins appear to make an angle of about 110° with the lateral walls of the cup, and its converging surfaces to be gently concave except about the apex.

Vertical walls of the sponge generally devoid of ornament except for a series of irregularly disposed vertical ridges and elongate nodes. These lie at subequal intervals and occasionally a single ridge may be traced for nearly the full length of the cup. The nodes seldom occur about the base, while they multiply toward the top, the ridges sometimes being resolved into a series of disconnected nodes, but frequently the ridge-like nodes appear in the interspaces between the ridges, and without order or arrangement. At the edge of the basal disc the ridges are abruptly transsected, making the margin nodose, as it is in the genus Thysanodictya. The surface of the periloph shows a more or less regular continuation of the ridges. The surface of the basal obcone or disc is wholly smooth and in this respect is in marked distinction to the generally exposed or vertical walls of the cup.

Mode of attachment. The convergence of the vertical spicular bands to the apex of the basal diaphragm and the usual imperfection of this apex are evidences of the attachment of the sponge at this point. Such attachment, however, was restricted to the apex of this obcone, and though similar to that in most of the Dictyosponges here considered, would have been inefficient in holding the sponge firmly in position. It is evident that important accessory

aid was contributed by the spicular bands of the periloph extending downward beyond the periphery of the disc. This extension bears in some degree the ornamental features of the lateral walls of the cup and many of the stronger spicular bundles of those walls were continued into it. The terminal or lower edge of the periloph is not regular, but where the ridges come down from above it is produced into short radiciform extensions.

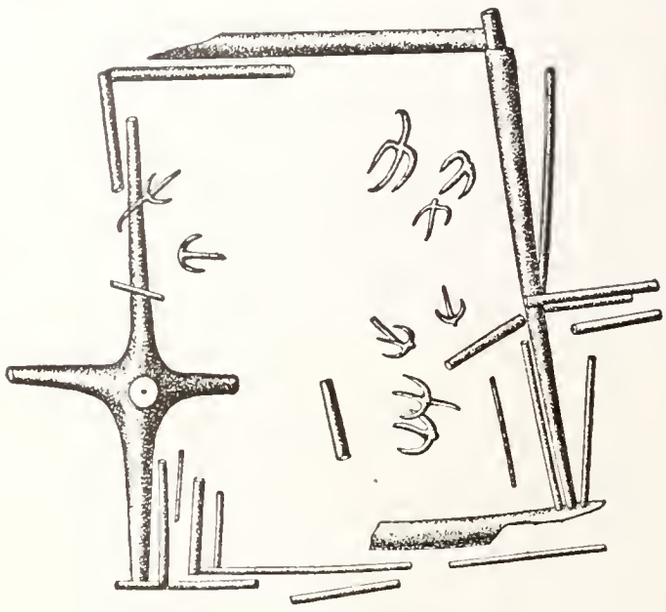
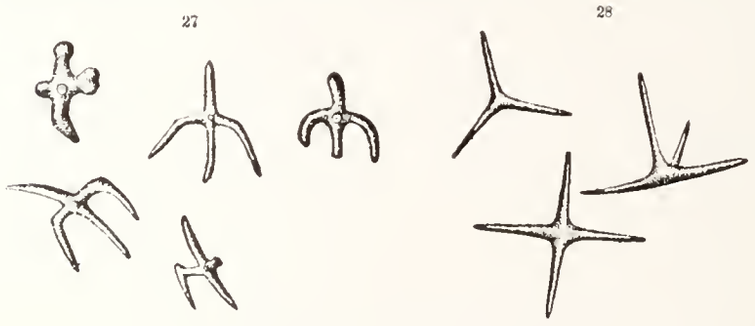


FIGURE 26. *Phragmodictya catilliformis.*

A minor mesh bounded by rods and pentactins, with curved pentactins or hexatins over the interspace. (J. M. C.)

Reticulum. The net-work of the sponge is exceedingly fine, and the subdivision very uniform. There are no strong bands of vertical or horizontal rods, and it is often difficult to find traces of them except near the base. On the surface of the basal obcone, however, the vertical or rather radial bands are very distinct, while the horizontal or concentric bands are less so.

Skeleton. The search for the spicular elements of the skeleton has shown that the rhabdus of the gastral and anchoring spicules are small and few in comparison with the other species whose spicular structure is known. The fine texture of the reticulum is due to quadrules, which for the most part, seem to be outlined by strong hexactins at the angles, their arms overlapping (fig. 26). These have long, smooth and acute branches. There also appear to have been pentactins or hexactins of great size with echinate arms, as indicated by the large fragment shown in figure 29, but had they been abundant we should probably know more of their form. The only other spicules of notable size are indicated by the slender fragments bearing long spinules, shown



FIGURES 27, 28. Spicules of *Phragmodictya catilliformis*, x400.

In figure 27 are curved pentactins like those seen in figure 26. In one of these spicules the arms end in knobs.

Figure 28 shows other modifications of the parenchymal spicules. (J. M. C.)

in the same figure. These may be parts of large pinuli, or still another style of cruciform spicule. Characteristic of this species are the curious pentactins or hexactins with curved arms, which lie scattered abundantly among the quadrules (see figs. 26, 27). Other modifications of the pentactin are shown in figs. 28 and 30. Considerable diversity of form is found among the diactins; some are elongate, pod-shaped, some stout and bean-shaped, others have a strong single curvature or a double curve. A few fragments have been seen which indicate diactins with clavate or spherical extremities. These are represented in figure 30. The only trace of anchorate spicules observed is a minute form shown in the same figure.

FIGURE 29. Fragments of echinate spicules of *Phragmodictya catilliformis*, x400. (J. M. C.)

The elements of the skeleton, taken as a whole, are quite distinct from those of the other species here described. The umbels and clemes, characterizing the genera PHYSOSPONGIA, CLEODICTYA, LYRODICTYA, etc., seem to be wholly wanting.

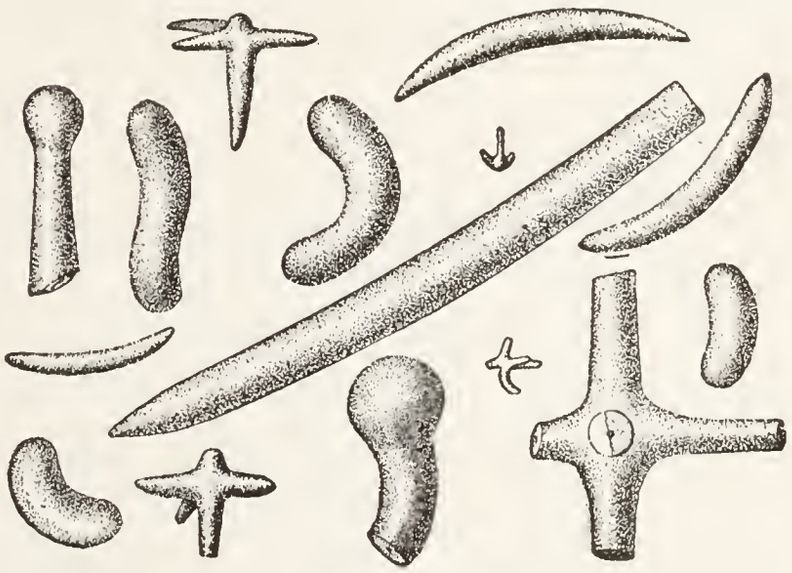


FIGURE 30. Spicules of *Phragmodictya catillíformis*, x400.
Here are shown various forms of diactine and cruciform spicules, and among them is a small anchorate clavule. (J. M. C.)

Dimensions. This species, which is the most abundant of all the forms occurring in the Crawfordsville shales, varies greatly in size. A young and essentially entire individual which probably retains the proportions normal for full growth, has a slightly curved cup, its length from the aperture to the distal edge of the periloph measuring 60 mm. The width of its aperture is 50 mm., its median diameter is 28 mm., and its basal width about 25 mm., the periloph having a length of 5 mm. A nearly entire specimen of average size, slightly incomplete at the aperture, has a length of 95 mm., the periloph is 15 mm. in length where longest, and the apex of the basal obcone is 9 mm. below the plane of its base. The largest cup observed has an apertural diameter of

230 mm. A basal diaphragm, 140 mm. in greatest diameter, bears a frill 45 mm. in width.

Locality. Keokuk group. In the calcareous shales, and rarely, in the overlying sandstone, at Crawfordsville, Indiana.

PHRAGMODICTYA PATELLIFORMIS, Hall.

PLATE LXV, FIG. 3.

1884. *Phragmodictya patelliformis*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 478.

The original specimen of this species is a large oval basal obcone with a highly eccentric apex. Its major diameter is 132 mm. and the apex lies 32 mm. from the nearest margin. The minor diameter through the apex is 100 mm., through the center 115 mm. The impressions of the radiating spicular bundles are strong, and the surface of the plate, which has been preserved in a calcareous nodule with its contour undisturbed, is gently convex. The aspect of this basal disc is unlike that of *Phragmodictya catilliformis*, in its much more eccentric apex and convex surface.

Locality. Keokuk group. In the calcareous shales at Crawfordsville, Indiana.

PHRAGMODICTYA (?) CREBRISTRIATA, Hall.

PLATE LXI, FIG. 4.

1884 *Phragmodictya (?) crebristriata*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pl. 21, fig. 7.

This fossil which has been illustrated in the place cited but not before described, appears to be an impression of a part of the flaring aperture of a Dictyosponge with an extremely fine reticulum, or part of an outer mould of a basal obcone with obscure nodes at the periphery. The radial spicular impressions, though fine, are distinct, while the reticulating bands are highly obscure. It probably represents a species unlike any of the others here described, but its generic characters are still uncertain.

Locality. Keokuk group. In the calcareous shales at Crawfordsville, Indiana.

(?) PHRAGMODICTYA LINEATA, Hall.

PLATE LXVIII, FIG. 5.

1884. *Phragmodictya lineata*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 478, pl. 21, fig. 8.

This name was given, in the work cited, to an imperfect specimen of a small subcylindrical cup, with moderately coarse reticulation and a surface

devoid of the ornamental nodes and ridges occuring in *Phragmodictya catilliformis*. The specimen was described as having an oblique, convex basal cone with a strong eccentric cicatrix, but upon a reexamination this supposed structure seems to be a portion of the lateral wall of the cup which has been broken and somewhat irregularly compressed. The characters of this specimen are not retained with sufficient clearness to demonstrate its specific value.

Locality. Keokuk group. In the calcareous shales at Crawfordsville, Indiana.

ACLŒODICTYA, gen. nov.

1882. *Phragmodictya*, Hall. Notes on the Family Dictyospongidæ; Expl. pl. 19, fig. 1.

1884. *Ectenodictya*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 476.

Subcylindrical sponges with strongly fenestrated exterior, as in Clathrospongia, and with abruptly obconical base, as in Phragmodictya. There is no periloph as in the latter genus and in Thysanodictya, and the vertical

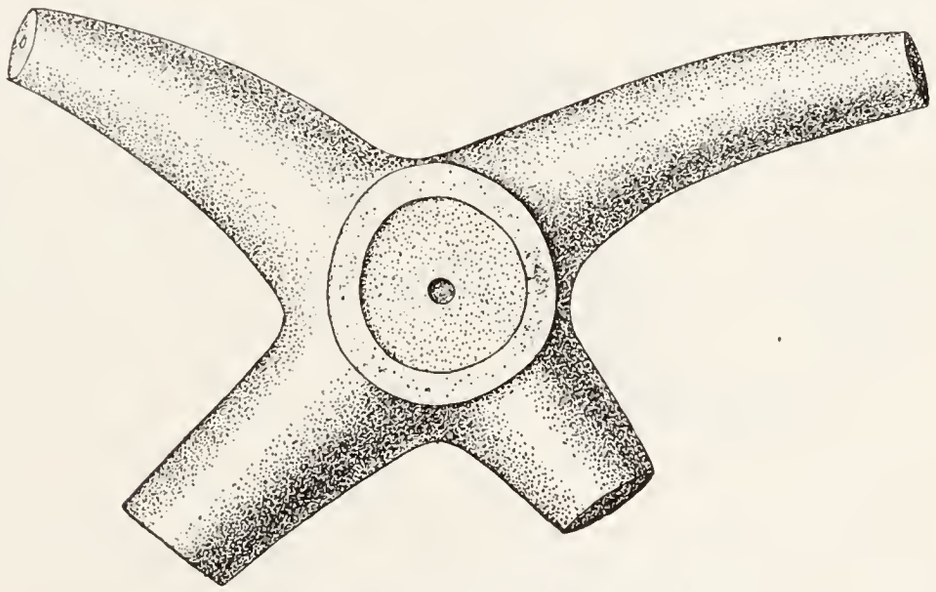


Figure 31. Large hexactin or pentactin of *Aclœdictya marsipus*, x400. (J. M. C.)

spicular bands converge irregularly to or about a broad apical point. The radial bands from one side are continuous across the disc and are reticulated by another set of radial bands from the other two quadrants of the disc.

Type, *Aclœodictya marsipus*, sp. nov.

ACLEODICTYA MARSIPUS, sp. nov.

PLATE LV, FIGS. 4, 5; PLATE LX, FIGS. 3–5; PLATE LXI, FIGS. 1–3; PLATE LXVIII, FIGS. 7, 8.

SPONGE robust, elongate, subcylindrical. Basal obcone, when uncompressed, expanding at an angle of about 50 degrees; continuing for not more than one-fifth the length of the cup, whence the surface, with a sharp but not angular bend, becomes abruptly erect in its growth. Near the basal disc the cup is at first broadly constricted, thence upward gradually expands and again narrows to the aperture. Thus the form of the sponge is that of a broad, medially inflated tube resting upon a shallow obcone.

Reticulum. The vertical and horizontal strands form meshes which are divisible into various series, though, with the usual preservation of the fossil, these differences are obscure. The primary series form quadrules which are about 10 mm. on each side, and these are divided by subordinate series in the usual manner Over the body of the sponge, both horizontal and vertical spicular bands were produced into erect reticulating lamellae which form a series of fenestrated areoles. The broadest of these lamellae may have a margin of 5 mm. A single poorly preserved specimen in which a portion of the pyritized skeleton is retained shows the presence of very large anchorate basalia with broadly divergent, smooth flukes and convex head. There are also great pentactins with curved arms, and clemes with short intervals between the acuminate lateral processes. These are forms similar to those occurring in PHYSOSPONGIA and CLEODICTYA. A peculiar pentactin (or tetractin) with short club-shaped arms, a form not observed in other species, occurs here among the parenchymalia. A figure is also given of a very small pentactin with long, straight and simple arms.

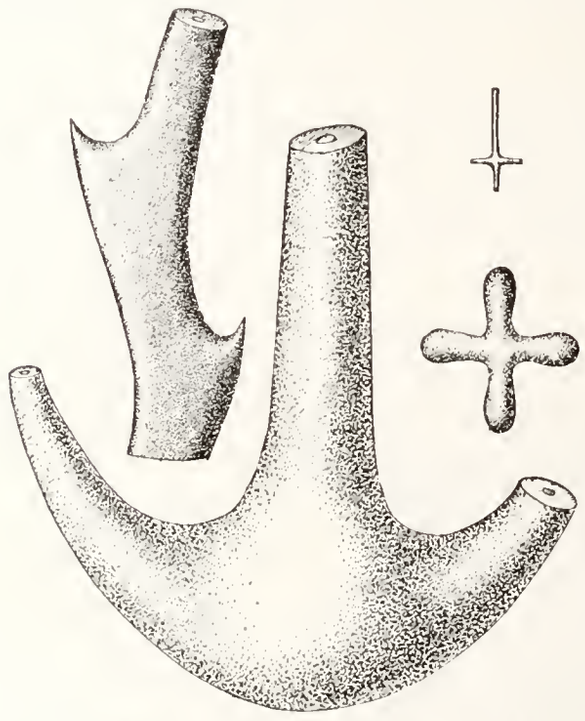


FIGURE 32. Cleme, anchorate clavule and stauractins of *Aclеodictya marsipus*, x400. (J. M. C.)

Dimensions. The largest and best preserved example, in which the sponge is compressed but essentially entire, has a length of 140 mm.; length

of basal obcone, 30 mm.; diameter at base of the cylindrical portion, 70 mm., at the middle, 85 mm.; at the aperture, 75 mm.

Localities. In the calcareous shales at Crawfordsville and Indian Creek, Indiana. (Largely from the collection of A. S. Tiffany.)

Aclæodictya (?) eccentrica, Hall (sp.).

Plate liv, Figs. 1, 2.

1882. *Phragmodictya eccentrica*, Hall. Notes on the Family Dictyospongidæ; Expl. pl. 19, fig. 1.

1884. *Ectenodictya eccentrica*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 476, pl. 20, fig. 1.

This species was based upon certain discoid bodies, marked by irregularly radiating and concentric spicular impressions, which converge about the central area. The aspect of the specimens suggests the basal obcone in *Aclæodictya marsipus*, but the reticulation is much finer than in that species and the surface toward the periphery shows undulations with a tendency to plication. Two of the specimens indicate that a portion of the vertical or radiating spicules from opposite quadrants of the disc are continuous over the apical region, while they are crossed by the spicules from the other quadrants, the radial spicular bands thus reticulating with each other. The concentric or horizontal bands also appear to be present on this apical area. No cicatrice is observable in the specimens.

The specimens which represent this species differ considerably in size, one having a semidiameter of 50 mm., the other of 80 mm. The entire diameter of another is 55 mm.

Locality. In the calcareous shales at Crawfordsville, Indiana.

GRIPHODICTYA, gen. nov.

Elongate subcylindrical sponges with subequally expanded base and aperture. No diaphragm or basal disc present (?).

Surface smooth. Reticulum very fine. Skeleton bearing a great number of hexactins with modified arms (oxyhexasters) and umbrella-shaped clavules of various forms.

Type, *Griphodictya epiphanes*, sp. nov.

The external characters of this sponge are not fully known, but its spicular composition is so totally unlike that of other forms that upon this

character both genus and species are founded. Sufficient is also known of the shape of the body to permit its recognition from the accompanying description.

GRIPHODICTYA EPIPHANES, sp. nov.

PLATE LV, FIG. 6.

SPONGE slender, originally subcylindrical or with the tube gently expanding to both extremities, the incurvature of the vertical walls being a

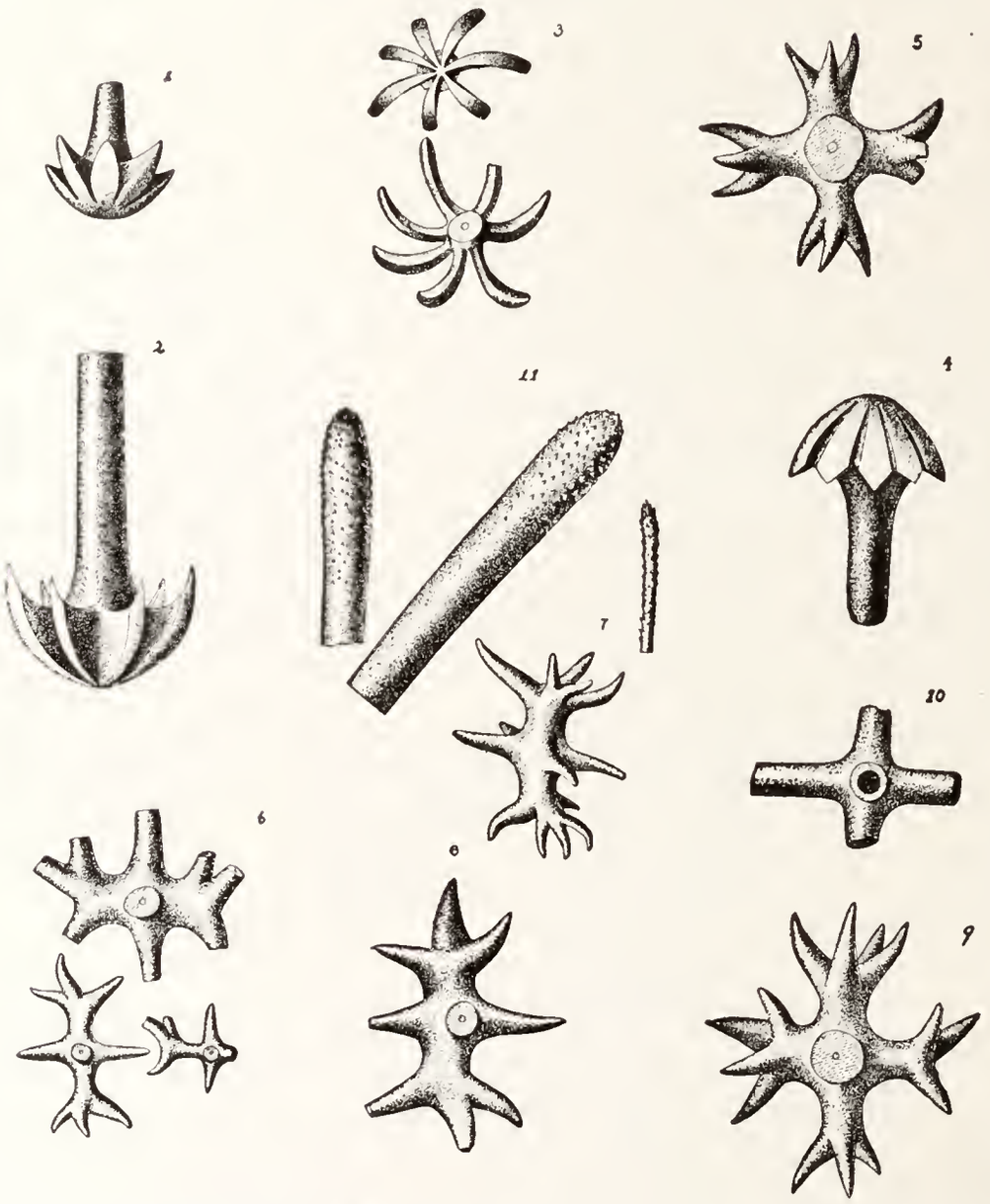


FIGURE 83. Spicules of *Griphodictya epiphanes*, x266. 1–4, umbels of different form; 5, oxyhexaster with the arms divided into three prongs each; 6, 7, 8, oxyhexasters with the arms of the horizontal axes unmodified and the others variously branched; 9, oxyhexaster with four prongs on two of the arms and three on the other two; 10, simple hexact or pentact; 11, fragments of echinate spicules. (J. M. C.)

very broad arc without interruption throughout its extent. The base of the sponge terminates abruptly in a broadly undulated margin by which attachment was evidently effected or aided, as in the case of the periloph of PHRAG-

MODICTYA. Apertural region somewhat more expanded than the base; margin of aperture regular and without tufts. Surface smooth, or with traces of obscure, discontinuous vertical ridges.

Reticulum very fine. The specimen is so preserved as to expose for nearly its entire length the inner surface of the wall, this being somewhat abraded about the base. At the summit a portion of the internal cast adheres, so that the entire thickness of the skeleton is here retained. Toward the lower part of the sponge may be seen remnants of two small, widely separated vertical bundles of stout smooth rods. No other vertical rods are apparent, while the horizontal rods, though minute, are so abundant and so matted together as to form a felt of spicules without any division into bundles. The prevalence of these quite obscures all traces of reticulation. The flesh spicules, which are extremely abundant over the upper part of the specimen, are large oxyhexasters with their rays variously modified; sometimes four of these rays are simple, while those of the third axis are divided each into three prongs; in other cases the rays of a single axis are simple and those of the other axes divided into three or four prongs. The prongs are not always of the same number in a hexaster, some of the rays bearing three, some four, and the prongs themselves being variously subdivided and often producing very complicated forms. There is some variation in size in these spicules as shown in the accompanying figures. Besides these hexasters, which seem to compose the greater part of the spicular mass, there are occasional fragments of regular hexactins, and numerous fragments of hexactin rays showing very finely echinate extremities. There are also two styles of umbrella-shaped clavules, one having a sharply tapering head with broad divisions, eight in number, the other considerably larger, with apparently seven highly divergent, narrow and acuminate divisions.

The specimen bears no little resemblance to a small, or young individual of *Phragmodictya catilliformis*, though showing no evidence of basal plate or frill, and it was regarded as that species until the examination of its skeletal structure demonstrated the impropriety of referring it either to this or any other known species of Dictyosponges.

Dimensions. Length, 54 mm.; basal width 20 mm.; median width 15 mm.; apertural width 25 mm.

Locality. In the calcareous shales at Crawfordsville, Indiana.

CALATHOSPONGIA, gen. nov.

(For description see page 155.)

CALATHOSPONGIA AMPHORINA, sp. nov.

PLATE LXVIII, FIG. 6.

SPONGE small, abruptly and broadly expanded at the aperture; body comparatively short, subcylindrical, having considerably less than one-half the width of the aperture; basal portion somewhat expanded, probably terminating abruptly. Surface without ridges, nodes or other irregularities.

Reticulum composed of very fine spicular bands, producing uniformly small meshes. On the internal cast there are no sharply defined quadrules but there is a notable predominance of the vertical spicular bundles which are individualized near the base but in ascending they become broadened and diffuse.

The single specimen has its flaring apertural portion bent over upon the body of the cup, but the original form of the sponge is very clearly shown. Part of the base is missing but the slight expansion of the cup in this region indicates a stout and abrupt termination.

Dimensions. The diameter of the aperture in the specimen described is 54 mm.; that of the body of the cup at the base of the aperture, 20 mm., and the entire length of the specimen 70 mm.

Locality. In the calcareous shales at Crawfordsville, Indiana.

CALATHOSPONGIA (?) MAGNIFICA, sp. nov.

PLATE LVI, FIG. 5; PLATE LVII, FIG. 1.

SPONGE of large size, funnel-shaped, probably subcylindrical about the body, rapidly and abruptly expanding toward the aperture. Form incompletely known. Surface more or less obscurely prismatic and without nodes or other irregularities.

Reticulum divided into large quadrules by horizontal intersections with the obscure prism-edges or spicular ridges corresponding therewith. These quadrules measure about 24 mm. on a side, over the body of the cup, but widen considerably toward the aperture. There are four or five subsidiary series of meshes in each quadrule of the first order, the reticulation of the entire surface being thus complete and regular. Probably the principal spicular bands were more or less elevated into erect lamellae.

Dimensions. We have represented two large fragments of this species, both showing the expanded upper portion and a part of the body of the cup. The larger of these has a length of 240 mm., a width below of 140 mm., and at the upper end the diameter, if entire, would be about 300 mm. The second specimen is smaller and shows a somewhat more rapid expansion of the cup. Both of these specimens have been compressed. Fragments of the species are not uncommon but are usually very imperfect.

Locality. In the calcareous shales at Crawfordsville, Indiana.

CLEODICTYA, Hall.

(For description see page 163.)

Cleodictya gloriosa, Hall.

Plate lxix, Fig. 1; Plate lxx, Figs. 1, 2.

1884. *Cleodictya gloriosa*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 479.

Sponge large, urceolate in form; rapidly expanding from a probably broad and flattened base into the single basal row of nodes, where it attains its greatest width; above this it is abruptly contracted, thence gradually expands with a smooth surface and graceful outward curvature toward the aperture. From the summit of the nodes downward, which was less than one-half the length of the cup, the surface is gently convex; above them the surface is concave.

The nodes are large, strongly convex, obtuse, wider vertically than horizontally and are directed obliquely upward resting on the crest of a horizontal ridge produced by the constriction of the cup. The number of these nodes is somewhat variable; the finest example bears ten of about equal size and shows an additional but incipient node in one of the dividing grooves. A second and smaller specimen has eleven fully developed nodes with an incipient twelfth. These facts indicate the probability of increase in the number of nodes with the growth of the individual as well as their numerical variation in different individuals. The external cast indicates that the nodes were not tufted nor any other part of the surface elevated into spicular lamellae. The grooves separating the nodes are broad and moderately deep, not, however, interrupting the general elevation of the ridge upon which the latter rest.

Shortly above the upper base of the nodes the surface contracts for about one-fourth the lower diameter of the cup, and its gradual expansion from this point upward continues, it is believed, without interruption to the aperture;

thus making the upper part of the sponge regularly vase-shaped with a circular cross-section. The actual extent of this vase and the precise form of the aperture remain unknown.

The *reticulum* is fine-meshed throughout and in no place is there evidence of conspicuous reticulating bands, the aspect of the net-work being very similar to that in species of CALATHOSPONGIA (e. g. *C. Redfieldi, C. Carlli*). The larger quadrules are minutely subdivided and vary in size and form as the curvatures of the surface vary. The fossil is in a sandstone and the spicules are not preserved.

This magnificent sponge attained commanding dimensions. The best of the specimens, which has lost something from each extremity, has a height of 190 mm. It has been somewhat compressed laterally and its greatest width at the lower end is 145 mm.; its width across the basal nodes is 215 mm. At its narrowest diameter, above the nodes, it measures 120 mm., and at the top about 140 mm. A smaller specimen representing the basal portion only, measures 115 mm. across the row of nodes.

Locality. From a sandstone of the age of the Keokuk group, overlying the calcareous shales at Crawfordsville, Indiana. (Collection of E. B. HALL.)

CLEODICTYA MOHRI, Hall.

PLATE LXX, FIG. 3.

1884. *Cleodictya ? Mohri*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 479.

SPONGE elongate, swollen below, broadly constricted and gradually expanding above. The base is broad and the expansion thence to the horizontal row of nodes is convex and rapid. This expanded portion of the sponge is relatively much longer than in other species of the genus, the nodes themselves being very obscure, elongate and but slightly elevated. Over one portion of the elevation on which they lie, where the reticulum is fully preserved, they are scarcely discernible. On the exposed half of the cup there are evidences of four nodes with a possible fifth. Above the nodiferous expansion, the contraction of the cup is gradual

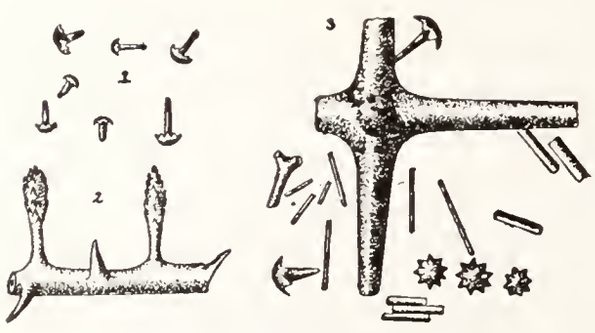


FIGURE 34. Spicules of *Cleodictya Mohri*.
1, Group of umbels, x60; 2, compound pinulus, x200; 3, hexactin surrounded by umbels and fragments of rhabds, x80. (J. M. C.)

for one-half the remaining distance, thence upward the expansion begins again and is continued to the aperture.

The *reticutum* is smooth and in its general aspect like that of *C. gloriosa* and *C. Claypolei*. Over the upper portion of the cup there is a series of

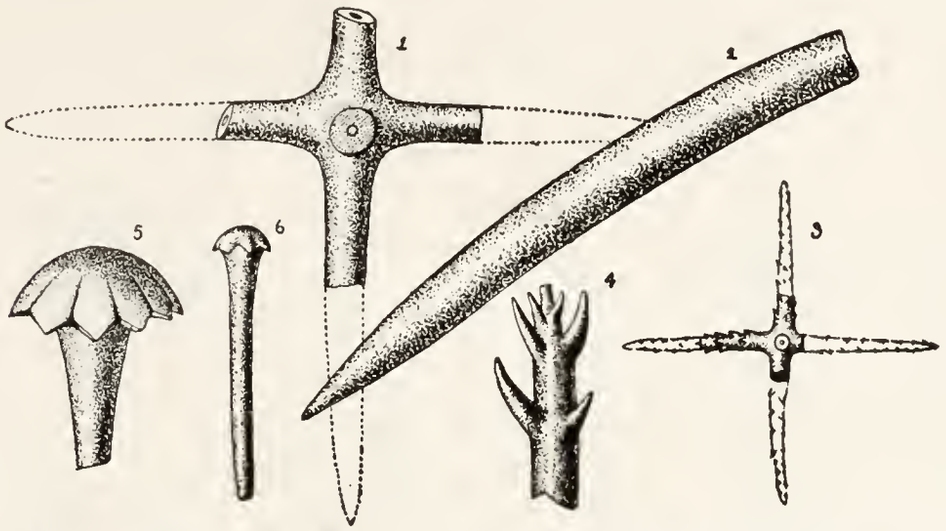


FIGURE 35. Spicules of *Cleodictya Mohri*, x400. 1, large hexact ; 2, extremity of rhabd or hexact; 3, echinate hexact; 4, extremity of large echinate hexact; 5, umbel; 6, micrumbel. (J. M. C.)

horizontal bands of spicules which are more conspicuous than the rest and are not crossed by vertical bands of corresponding size at regular intervals.

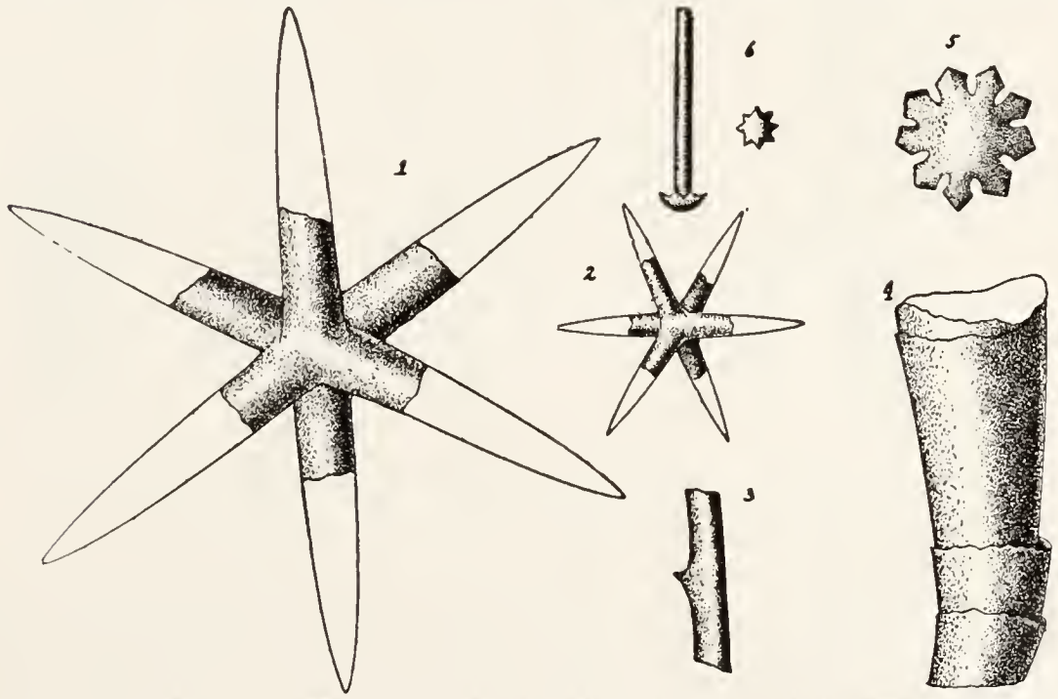


FIGURE 36. Spicules of *Cleodictya Mohri*, x400. 1, 2, hexacts; 3, small cleme; 4, rhabd showing concentric layers; 5, 6, umbel and micrumbel. (J. M. C.)

Above the basal expansion the vertical bundles of spicular rods or rhabds lose their close definition and are spread over the quadrules somewhat to the

obscuration of the latter. There is much variation in the size of these rods, large and small ones being bundled together. In figure 37 is shown the terminal portion of one such rod. A close examination seems to establish the fact that the majority of these *lateralia* terminate before reaching the basal expansion and those which continue to the base of the cup are mainly the rods of largest diameter. The horizontal bundles are of similar size, but individual rods are frequently as large as any occurring in the vertical

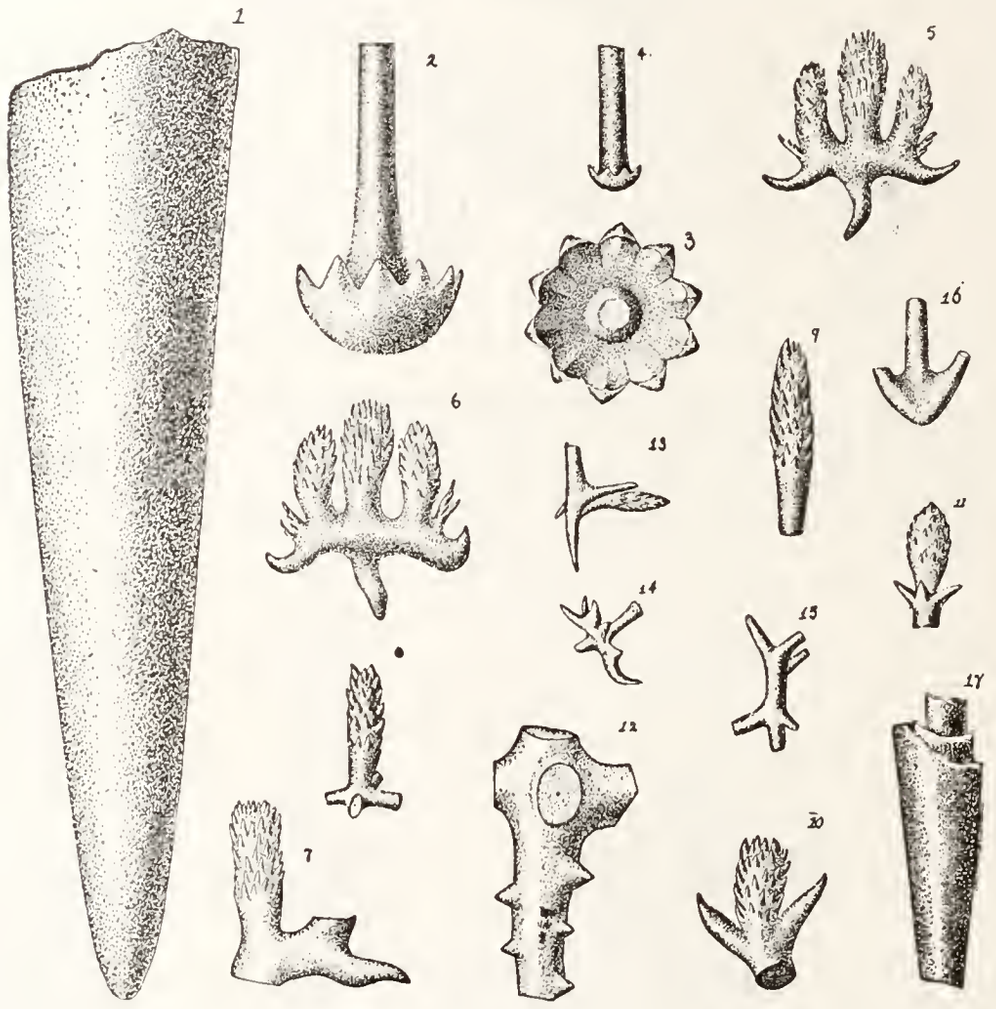


FIGURE 37. Spicules of *Cleodictya Mohrt*, x400. 1, Terminal portion of vertical rod; 2, umbel; 3, the same from beneath; 4, micrumbel; 5, 6, the two sides of an entire tripinulus; 7, 9, 10, 11, 13, various fragments of pinulus forms; 8, incomplete amphiaster; 12, echinate hexact, 14, 15, *spiculæ innominatæ*; 16, anchorate clavule, 17, rhabd showing concentric layers. (J. M. C.)

series. The ultimate quadrules, which measure about .5 mm., have at each angle regular hexactins whose arms traverse more than one-half the length of the contiguous squares, the extremital portions of adjacent spicules overlapping. The outer vertical arm is sometimes modified into a blunt node. Such hexactins are shown in figures 34, 35 and 36. There are also other regular hexactins of large and small size with echinate arms, as shown by the frag-

ments represented in figure 35. The smaller of these probably belong to the parenchymalia but the larger has not been located.

There is a very considerable variety in the forms which may be referred to the parenchymalia and dermalia. Perhaps the most striking of these are the large and small umbels (umbels and micrumbels; figs. 34, 35, 36 and 37). These are like the dermal clavules which have been figured by F. E. Schulze in the recent species *Farrea occa*,* except that here the shafts are always short and smooth, gently swollen beneath the umbels, and the teeth of the umbels smooth. They evidently have nothing to do with the anchoring spicules or basalia, and the same is probably true of the anchor-shaped fragment shown in fig. 37 (16) which was taken from the upper part of the cup. To the dermalia may also be referred the peculiar compound tri-pinulus, both sides of the complete form of which are shown in figure 37 (5, 6). The morphology of this spicule is not readily apprehended. There are also other peculiar pinulus forms as shown in figures 34 (2) and 37 (7, 9, 10, 11, 13), which are as yet incompletely known. In figure 37 (8) is an imperfect amphiaster belonging to the parenchymalia.

Dimensions. The original specimen measures 130 mm. in height, 70 mm. in diameter at the base, 100 mm. across the nodose expansion, 65 mm. where narrowest, and about 75 mm. at the upper end which is imperfect.

Locality. In the calcareous shales at Crawfordsville, Indiana.

PHYSOSPONGIA, Hall.

1881. *Uphantænia*, Whitfield. American Journal of Science, vol. xxii, p. 132.

1881. *Uphantænia*, Dawson. American Journal of Science, vol. xxii, p. 132.

1881. *Uphantænia*, Whitfield. Bull. No. 1, Amer. Mus. Nat. Hist., p. 15.

1882. *Physospongia*, Hall. Notes on the Family Dictyospongidæ; Expl. pl. 19.

1884. *Physospongia*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 467, 479–481.

The fossils of this genus have the form of a diminutive basket with broad strands and coarse meshes. The upright body has a very gradual expansion from the base upward and its surface was probably regular, as far as appears from the usual mode of preservation, though it is possible that, when compressed, the strong vertical strands of the spicules may have given it a somewhat prismatic form. Normally the surface bears two series of these vertical

* Hexactinellidae, pl lxxi, figs. 3, 5, 9.

spicular bands, one broad and conspicuous, its members alternating with a series of narrow bands. In the type-species, *P. Dawsoni*, where all generic features are most clearly defined, these bands are generally placed at equal intervals, but there may be in other cases, and even in this species, considerable variation in this respect. By the crossing of the concentric or horizontal spicular bands, which are narrow, of equal breadth and nearly equidistant, the area enclosed by any two of the broader vertical bands is divided into subequilateral quadrules, and each of these quadrules is again divided into four quadrules by the intersection of a vertical band of the second order with a horizontal band. Of the four quadrules thus formed two are elevated into bullate expansions or pouches, the other two are depressed into regularly concave basins; nodes and depressions alternating in position so that normally every node is surrounded by four depressions and every depression by four nodes, each at the same time being separated from every other by spicular bands. Considerable irregularity in the disposition of these elevated and depressed areas is sometimes shown by *P. Colletti*, while the little known *P. multibursaria* in this structure quite fails to conform with our conception of the genus.

As usually preserved the tops of the surface nodes are broken off, or by adherence to the matrix give the impression of a vertical series of areoles, but normally the surface of these nodes and depressions is continuous and finely reticulated by regularly disposed interlacing pentacts. All specimens observed have been more or less subjected to compression and it is possible to ascertain the full elevation of the nodes only along the edges of the cup. In such marginal sections we also find evidence of extensions from the horizontal spicular bands into slender erect tufts. These always occur at the intersection of the horizontal and vertical bands, and it is probable that they were developed at every such intersection. The spicules of the vertical bands do not appear to have been complicated with those of the horizontal bands in the formation of these tufts.*

There is certainly a striking similarity in external structure between PHYSOSPONGIA and the great explanate or saucer-shaped bodies already described as HYPHANTÆNIA, and which occur in the form of impressions in the sandstones of the Chemung group. Our knowledge of HYPHANTÆNIA is still incomplete but we know that the intervals between the vertical and horizontal or concentric spicular bands were partially if not wholly covered by spongin.

* In the brief original description of this genus these tufts were regarded as originating from the summits of the nodes.

Similar skeletal structure is also to be found in the genus Roemerispongia of the middle Devonian of Germany (*R. Gerolsteinensis*, F. Roemer; see part 1, page 67).

In American faunas species of Physospongia are known only from the Keokuk group, all specimens having been derived from the calcareous shales in the vicinity of Crawfordsville, Indiana.

Physospongia Dawsoni, Whitfield (sp.).

Plate lxii, Figs. 1–10.

1881. *Uphantœnia Dawsoni*, Whitfield. American Journal of Science, vol. xxii, 3d ser., p. 132.

1881. *Uphantœnia Dawsoni*, Whitfield. Bull. No. 1, Amer. Mus. Nat. Hist., p. 15, pl. iv, figs. 1, 2.

1882. *Physospongia Dawsoni*, Hall. Notes on the Family Dictyospongidæ; Expl. pl. 19, figs. 4–6, 8 (not fig. 7).

1884. *Physospongia Dawsoni*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 479, pl. 19 (20), figs. 4–6, 8.

Sponge subcylindrical over the body and lower portion, expanding somewhat more rapidly toward the aperture. In the majority of specimens the cup seems to taper quite rapidly toward the base, but the base itself was evidently broadly obtuse, and in some instances slightly expanded. This portion of the cup is seldom retained. Size comparatively small, rarely exceeding a length of 75 mm. with a nearly equal width at the aperture when under compression. As usually preserved the width of the cup at the upper end is about one third greater than at the lower end; occasionally the former is twice that of the latter.

Reticulum. The primary reticulation of the surface is very coarse and is produced by a double series of vertical spicular bundles intersecting a single series of horizontal bands. Of the vertical bundles the principal series is broad and flat, its width being from three to five times that of the secondary series. There is a notable increase in width from below upward in the principal bundles, as occurs in *P. Colletti*. The principal and secondary vertical bundles alternate in position and are equidistant, the latter equally dividing the area set off by the former. The horizontal bands are narrow, carrying about the same number of spicular rods as the secondary vertical bundles. The intersection of these with the principal vertical bundles divides the surface into equal quadrules, each of these being sub-divided into four equal

parts by the intersection of the horizontal with the secondary vertical bands. Two of the quadrules thus formed are elevated into regular convex pouches or nodes, the other two are concave, and it seems probable that the curvature of the concavity was originally equal to that of the node. These elevations and depressions alternate in position and thus each node is surrounded by four depressions and each depression by four nodes. The general surface effect produced by this arrangement is that of a series of double vertical rows of nodes separated by the broad vertical spicular bands. The number of the primary vertical bands is usually twelve, though some specimens seem to have had not more than ten.

FIGURE 38. *Physospongia Dawsoni.* A group of anchors and a cleme. x60. (J. M. C.)

Growth. The younger parts of the specimens usually show a diminution in the size and in the development of the surface nodes and depressions, and when the actual basal parts of the cup become known they probably will be found comparatively free of the usual surface conformation. Near the apertural margin also the nodes become less distinct, that is, less elevated, though often of greater area. The duplication of the nodes and depressions as an accompaniment of growth in the expansion of the cup, such as occurs frequently in *P. Colletti*, is very rarely observed in this species.

Skeleton. In the remarks already given upon the structure of the skeleton of the thin-fleshed Dictyosponges, it has been observed that the tuft of basal spicules or basalia is but a continuation and union of the long vertical spicular bundles which, with the horizontal bands, produce the characteristic reticulation of the surface. Further evidence from analogy with living hexactinellids, as well as from the facts themselves, is that these lateralia or upward extensions of the basalia lay within the sponge and probably bounded the surface of the great gastral cavity. The flesh-wall of the sponge, however, was so exceedingly tenuous that in the best preserved of the DICTYOSPONGIDÆ it is usually extremely difficult to distinguish the gastral from the dermal surface as far as shown by differences of structure.

In *Physospongia Dawsoni* the innermost or true gastral surface of the principal lateralia bears only long cylindrical rods, varying notably in size. These may frequently be followed for the length of two or three quadrules

without interruption, and probably were originally continuous to the base of the sponge. The upper or outer portions of these spicular bundles contain numerous small cylindrical rods which terminate in a two-pronged anchor, each barb or prong tapering backward toward the aperture into a slender rod ending in a point. The head of the anchor is considerably inflated on the smooth surfaces and its apex or point is blunt. The size of the anchors varies somewhat, as shown in the accompanying figure, both enlargements to the same degree. These anchorate spicules are scattered, often abundantly, throughout the entire length of the lateralia and could have had nothing to do with the fixation or anchoring of the sponge.

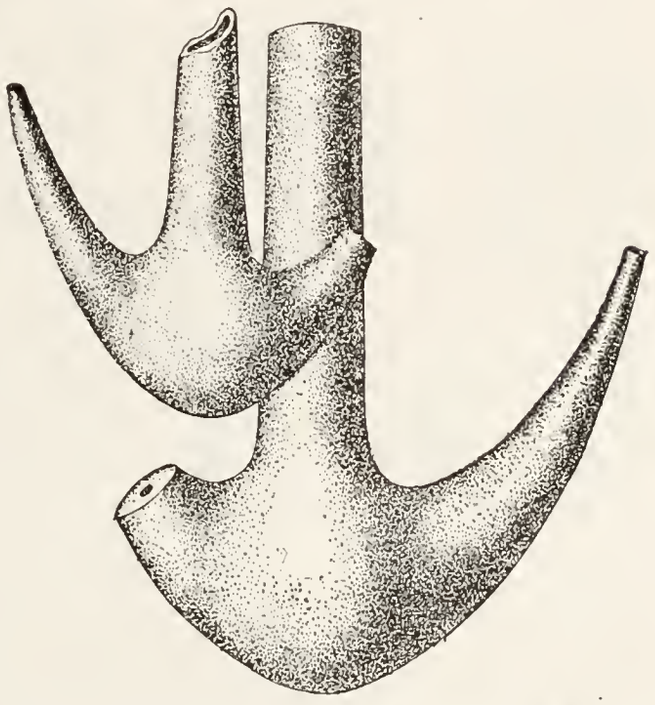


Figure 39. *Physospongia Dawsoni.* The heads of two anchorate spicules. x400. (J. M. C.)

Together with the anchorate spicules or just above them and on the outermost layer of the bundles, is a series of parallel twigs or clemes which have been described as somewhat flattened rods expanded alternately first on one lateral margin and then on the other, into elongate triangular surfaces whose outer or marginal angle is acute and continued a short distance backward into a very slender rod-like extension. Between this and the edge of the spicules the margin of the triangle is gently incurved. The intervals between the triangular expansions vary somewhat, and the spicules themselves are generally more slender than the rods of the gastral surface, though they are seen to be of considerable length. One specimen, which happens to be the original of *Uphantœnia Dawsoni*, Whitfield, is so broken that a portion of these vertical bundles remains on the interior or gastral cast and the rest or outer portion on the enclosing rock. The former of these fragments is figured by Whitfield

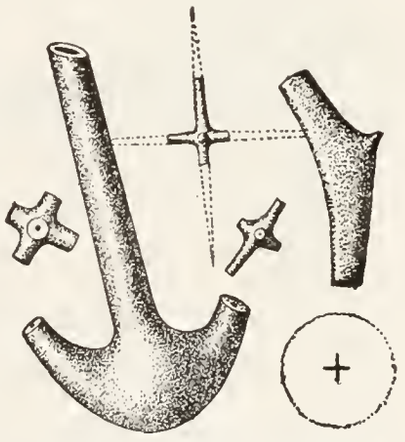


Figure 40. *Physospongia Dawsoni.* A group of spicules. The stauractin in the circle is enlarged 30 diameters; the others 250 diameters. (J. M. C.)

(loc. cit. fig. 1). The separation is of such a nature that only the cylindrical rods adhere to the gastral cast while the anchorate spicules and clemes are beautifully displayed in their original position upon the enveloping matrix. The secondary vertical lateralia and the horizontal reticulating bands are composed of comparatively few cylindrical spicules, some of which attain a greater size than any observed in the principal lateralia, but neither of these series has shown any trace either of the anchorate or of the clemate spicules.

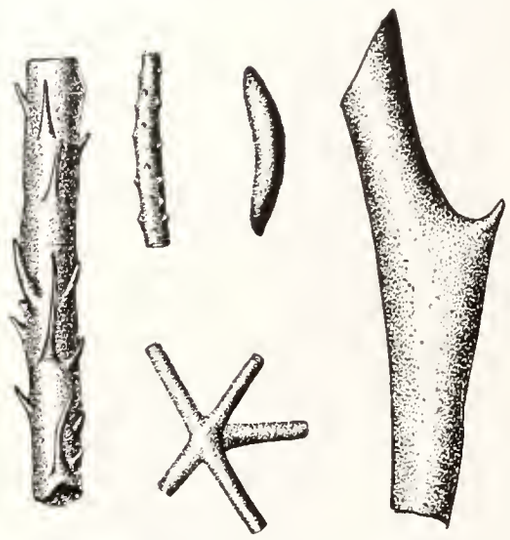


FIGURE 41. Spicules of *Physospongia Dawsoni*, x400. Fragments of echinate hexacts, a smooth-rayed pentact, a diact and part of a cleme. (J. M. C.)

Mention has been made of the radiate tufts produced by the extension of the horizontal spicular rods at their intersection with the vertical lateralia of both series. The spicules of the horizontal lateralia appear to lie nearer the gastral surface than do the principal and secondary vertical bundles. At the intersection of the horizontal and vertical bundles are occasionally seen large pentacts, sending a ray along each bundle departing from that point, the fifth ray passing inward. These pentacts are the heaviest parts of the skeleton, and as they lie above or outside of the lateralia they probably belong to the dermal surface.

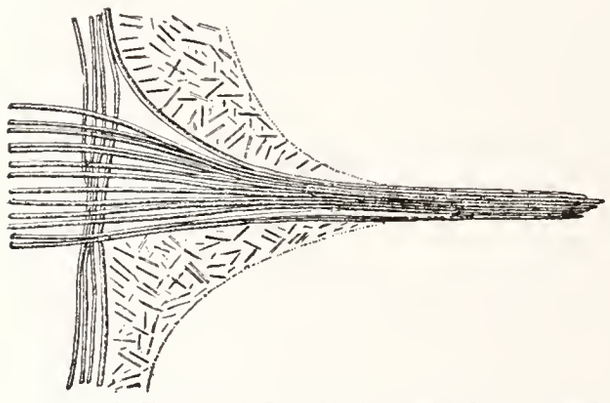


FIGURE 42. *Physospongia Dawsoni*. A somewhat diagrammatic figure of one of the spicular tufts. x10. (J. M. C.)

The dermal surface of the quadrules formed by the intersection of the lateralia is regularly and very finely reticulated by smooth-rayed pentacts lying in apposition. These vary in size but are never more than one-tenth as large as the smooth pentacts at the intersection of the lateralia. Among the spicules which evidently belong to the parenchyma of the sponge are numerous fragments of echinate branches, some of which undoubtedly are parts of echinate hexacts, as that represented in figure 41. The same figure shows a fragment of a large spicule in which the surface spinules are more produced than in any of the echinate spicules of other species. This form of spicule seems to be of rare occurrence in the species, and from analogy with *P. Colletti*, *Cleodictya*

gloriosa, and other species, we have to conclude that it belongs to a large hexact or pentact whose precise position in the skeleton still remains in doubt.

Smooth, elongate siliquate diacts (figure 41) of small size are occasionally found among the parenchymalia.

After careful search this species has afforded no evidence of umbels such as occur in *P. Colletti and Cleodictya gloriosa*. Nevertheless it seems probable that they exist, though they may be of great rarity.

Dimensions. The size of this species, in comparison with its closest ally, *P. Colletti*, is always small. An individual of rather large dimensions has a length of 70 mm., an apertural diameter of 80 mm., and a basal diameter of 30 mm. Fragments of somewhat larger examples have been observed. An average specimen which seems to be complete, is 45 mm. in length, has a basal width of 50 mm., contracting above this to a width of 44 mm. and expanding again to an apertural diameter of 60 mm.

Locality. *Physospongia Dawsoni* is known only from the calcareous shales of the Keokuk group at Crawfordsville and Indian Creek, Indiana.

Physospongia Colletti, Hall.

Plate lxiii, Figs. 1–7.

1884. *Physospongia Colletti*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 480, pl. xx, fig. 7.

Sponge large, rapidly, and sometimes unsymmetrically expanding from a broad base to a wide aperture.

Surface highly nodose, similar in structure and aspect to that of *P. Dawsoni*, but with nodes of much greater size, and with more frequent irregularities in their arrangement.

Reticulum. The primary and secondary vertical bundles are of very unequal size. The former are broad and compact over the lower portion of the sponge but become diffuse above, spreading into a fan-like brush near the aperture and obscuring thereby some of the main quadrules. Over the median and lower portion of the cup the quadrules are nearly square but toward the aperture both nodes and concavities become transverse, the horizontal diameter increasing and the vertical diameter lessening, until each division becomes very narrow. Thereupon ensues a multiplication in the number of vertical rows of nodes and depressions, the two rows of any one of the main vertical divisions of the surface increasing to four, and the area occupied by each large node or depression over the body of the cup bears two small nodes and corresponding depressions. This duplication of the vertical rows of quadrules is

shown in figs. 5 and 6 of the plate cited. The aperture of the cup appears to be smooth and its margin regular and even, without processes or spicular projections.

Skeleton. As in *Physospongia Dawsoni*, the vertical bundles in this species are composed of a great number of smooth rods, there being associated with them anchors and clemes. In the material under examination the spicular structure is not very satisfactorily retained, but it would seem as if these anchorate and clemate rods were comparatively less abundant than in *P. Dawsoni*, and they prove to be of somewhat smaller size. The predominant pentactins are of large size and strongly echinate. It is presumed that these lay at the angles of the quadrules and their abundance is in contrast to the comparatively rare occurrence and small size of similar bodies in *P. Dawsoni*. The surface of the nodes and depressions is very minutely and retangularly reticulated but so little of the spicular framework over those areas has been preserved that only the large umbel (fig. 44) can be referred thereto. It has been observed that although the specimens of *P. Dawsoni* have afforded much more satisfactory means of studying the spicular elements of the skeleton, no umbels have been found in that species. Presumably in *P. Colletti* spicular tufts were present at the intersection of the

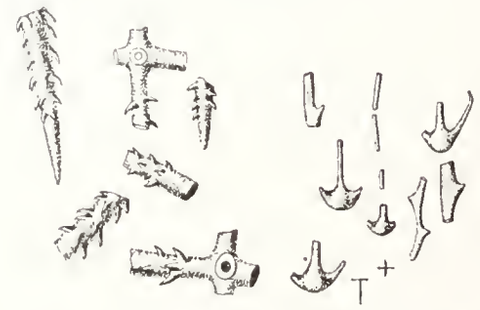


FIGURE 43. Spicules of *Physospongia Colletti*; fragments of clemes, anchorate clavules and echinate hexactius, etc. x65. (J. M. C.)

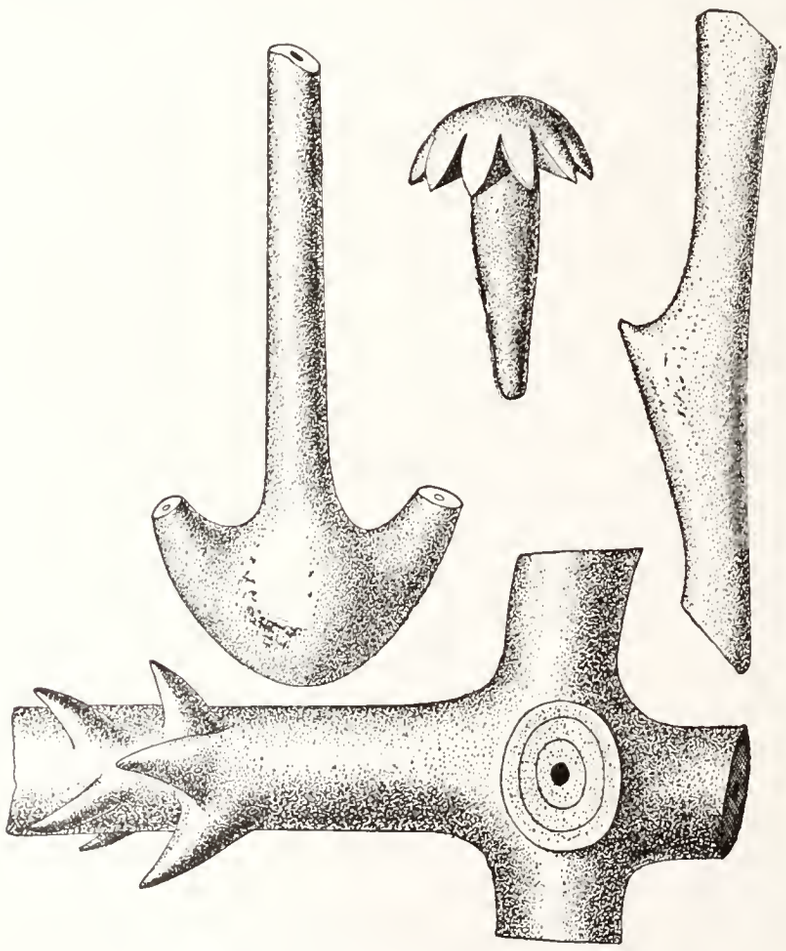


FIGURE 44. Spicules of *Physospongia Colletti*. x400. (J. M. C.)

horizontal and vertical spicules, as in *P. Dawsoni*, but no satisfactory evidence of them has been observed.

Dimensions. A specimen which preserves the upper portion of the cup for a length of 82 mm. has an apertural width of 150 mm. and a diameter at the lower end of 80 mm. Another example which represents the basal and median parts of the sponge, is 90 mm. long, 105 mm. wide at the top, and 55 mm. wide at the base. Both of these specimens have been laterally compressed.

Locality. In the calcareous shales at Crawfordsville, Indiana.

Physospongia alternata, Hall.

Plate lxii, Fig. 11.

1882. *Physospongia alternata*, Hall. Notes on the Family Dictyospongidæ. Expl. pl. 19, fig. 9.

1884. *Physospongia alternata*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 481, pl. xx, fig. 9.

The few specimens of this species which have been observed show a narrow subcylindrical tube with a length of about 40 mm. and a width of 25 mm. That these undoubtedly represent a specific form distinct from the others here described is shown, first, in the subequal width of the vertical lateralia, and second, in the comparatively slight development of the alternating elevated and depressed quadrules.

The vertical and horizontal spicular bands are narrow, subequal in width, about equally distant from one another and hence the quadrules formed by their intersection are nearly square. The number of double rows of squares is but six at the lower part of the specimen, but towards its upper part there is a duplication of one of the rows by the development of a new vertical spicular bundle, such as frequently appear in *P. Colletti*. It has not been possible to fully investigate the spicular skeleton of this sponge. Some of the vertical lateralia bear clemes similar to those of the other species of Physospongia, but no anchorate rods have been observed. Large pentacts lie at the angles of the meshes and small pentacts and smooth-rayed hexacts are found over the quadrules.

Locality. Keokuk group, Crawfordsville, Indiana.

PHYSOSPONGIA MULTIBURSARIA, sp. nov.

PLATE LXI, FIG. 7.

This is an aberrant form, referred to the genus PHYSOSPONGIA, pending a more complete knowledge of its structure. The single specimen represents a portion of one side of what must have been a very large sponge of whose original proportions it is not possible to form an accurate conception. The surface is flat and measures 175 mm. in length and 110 mm. in its greatest diameter. This expansion is covered with a great number of small, rounded elevations having the form of drooping pouches, the smaller of them resembling the nodes of *Physospongia Dawsoni*, but the longer appear to have been of the pendulous nature of the lobes in BOTRYODICTYA though of much smaller size. These nodes are arranged in vertical rows although there are portions of the surface where the order is somewhat obscured by the overlapping of

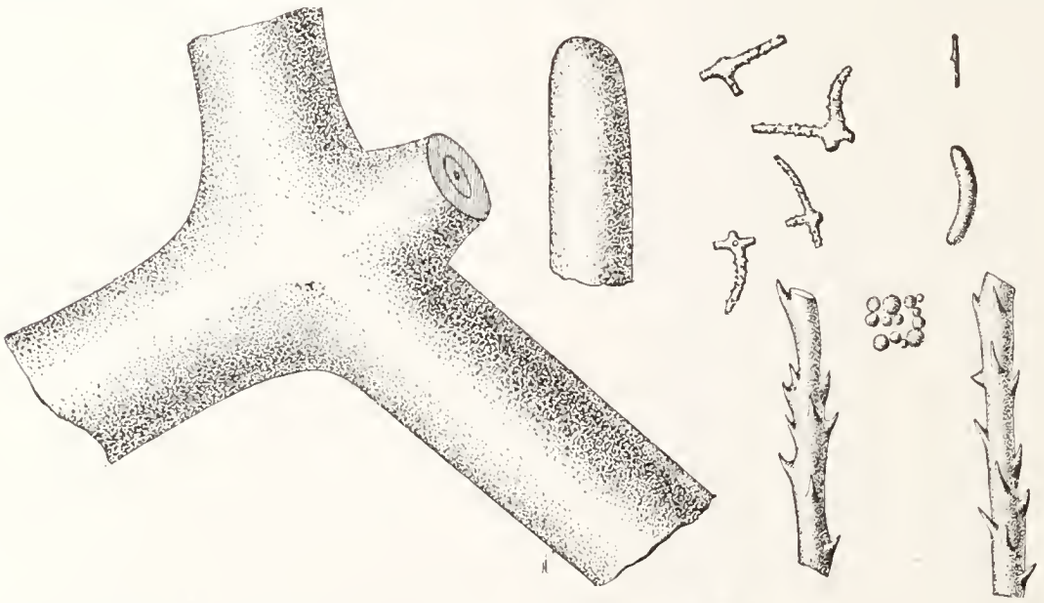


FIGURE 45. Spicules of *Physospongia multibursaria*, x400. Showing a large irregular pentact, fragments of echinate hexacts, smooth diact and a minute cleme. (J. M. C.)

the longer nodes. At the bottom of the specimen, thirteen of these rows may be counted, while toward the top, where the surface is broadest, there are as many as twenty. No arrangement into transverse rows can be distinguished.

A few of these processes show traces of reticulation about their basal portions or over their summits, but where the interspaces are uncovered or the nodes have been removed, the impression of a fine spicular net-work is everywhere seen. The unbroken marginal portion at the right of the specimen is without nodes, and here the reticulum is partially preserved in pyrite.

The meshes and spicular bands appear to be in two not very clearly marked series, the principal bands, so far as can be seen, being from 3 to 5 mm.

apart which is the width of the nodes. The bands themselves are extremely narrow. There is no such prominent development of bundles of lateralia as in the typical species of Physospongia, a fact which, of itself, is suggestive of probable different generic relations in this species. Some small portions of the skeleton which have been submitted to microscopic examination show very large pentactins with blunt extremities, such as are shown in figure 45. These were probably at the junction of the larger transverse and horizontal bands. There are also small, echinate pentactins or tetractins, some larger fragments indicating similar spicules of more conspicuous size, and small sausage-shaped diactins. The little cleme represented in the figure shows the extreme minuteness of certain elements of the skeleton. Throughout the mass examined are clusters of minute spheres of pyrite, which at first impression would seem of concretionary origin; it may, however, be possible that these are modified spicules (diactins?). No evidence has been found of the umbels (clavules), anchors and plumes of *Physospongia Dawsoni*.

Locality. In the soft shales of the Keokuk group, Crawfordsville, Indiana.

EXPLANATIONS OF PLATES.

PLATE I.

CYATHODICTYA, nom. propos.

Page 24.

CYATHODICTYA RETICULATA, Walcott (sp.).

Page 24.

Figures 1–6. A series of young specimens, all of natural size, showing gradation in form, and most of them retaining the reticulum more or less completely.

Figure 7. An unusually large example, its spicular structure somewhat conventionally reconstructed in places, showing the arrangement of the spicular elements and, beneath the reticulum, the irregularly distributed areoles outlined in an unresolvable mass of pyrite.

Figure 8. The apertural portion of an average cup, torn at one side; enlarged to show the finer spicular net-work about the margin. x 3.

Figure 9. An individual of somewhat less than average size.

Figures 10, 11. The apertural extremities of two individuals. The apparent thickness of the spicular wall is due to slight incurvature about the aperture. x 3.

Figure 12. The basal extremity of an average specimen; showing the extension of the reticulum into a short basal tuft. x 3.

Figure 13. An enlargement of a portion of the reticulum, showing the different series of simple cruciform spicules, and the underlying layer with its areoles. This inner layer is unresolvable, its substance as preserved being granular pyrite. It will be observed that the areoles are irregularly disposed and are covered by spicules of the outer frame-work. x 5.

Utica slate. *Holland Patent, New York.*

SPHÆRODICTYA, gen. nov.

Page 26.

SPHÆRODICTYA SUBSPHÆRICA, Walcott (sp.).

Page 26.

Figure 14. A cluster of young individuals of various sizes, showing peripheral spicules on some of the specimens.

DICTYOSPONGIDÆ.

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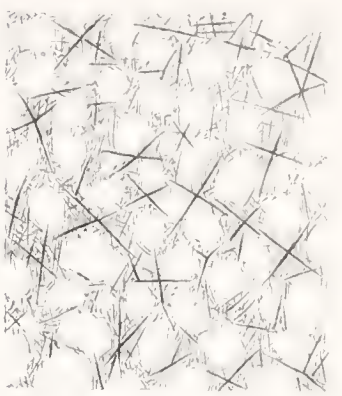

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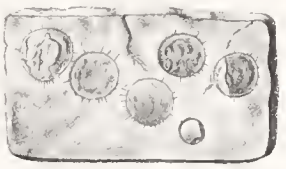

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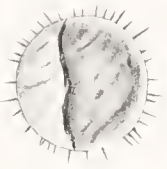

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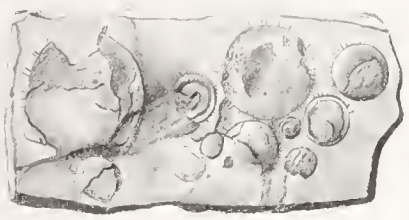

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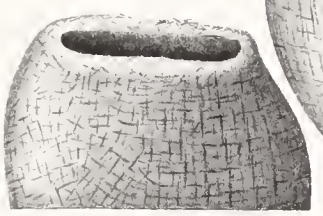

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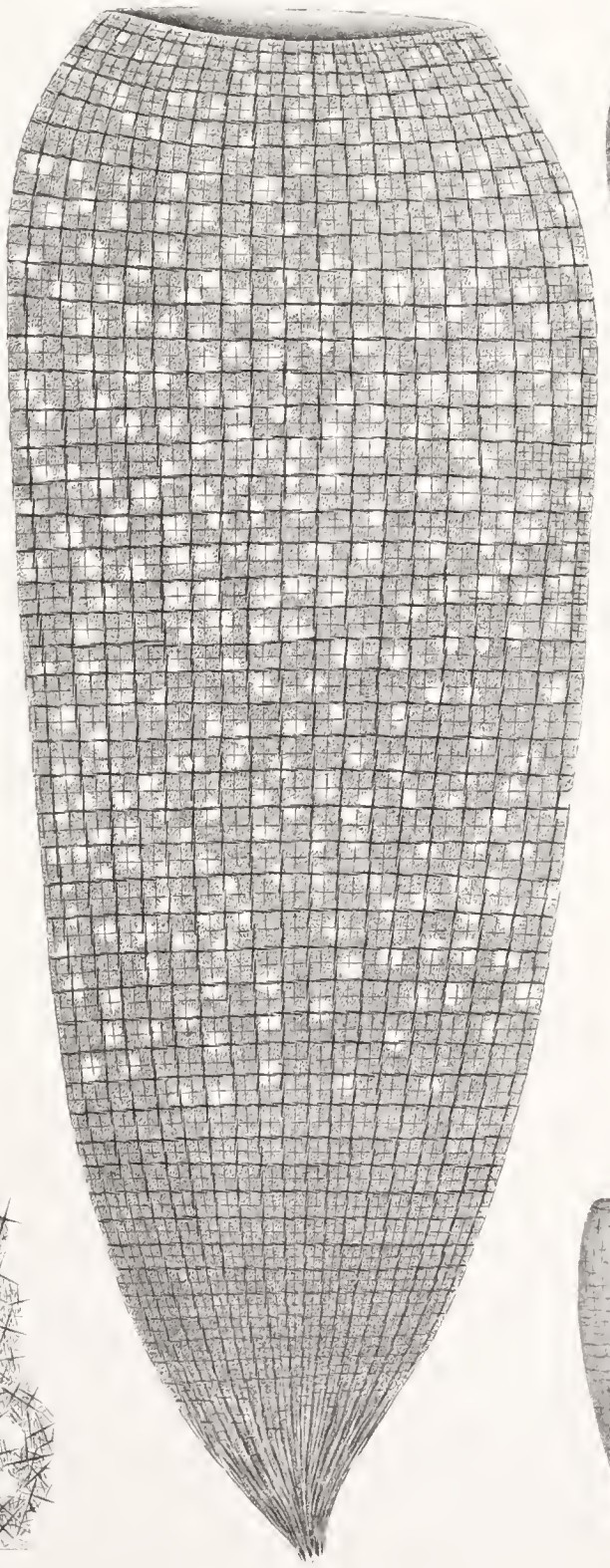

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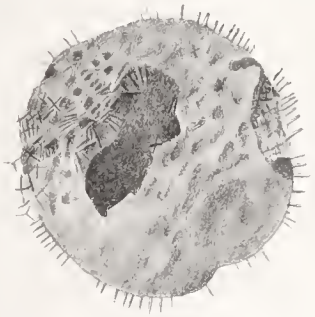

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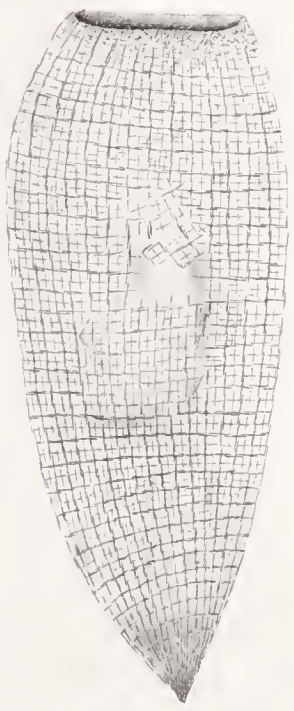

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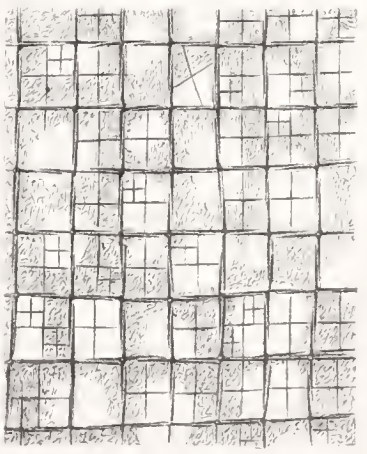

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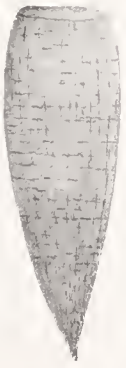

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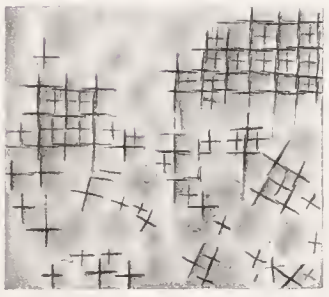

Figure 15. One of the two largest of the specimens in this group, enlarged; showing the peripheral spicules, and the cruciform spicules over a part of the wall. The surface is a continuous pyrite film with an irregular break near the center, due to the adhesion of a part of the film to the opposite side of the matrix. The specimen from which these two drawings have been made was loaned for the purpose by the U. S. National Museum and is one of the specimens upon which RAUFF based his conception of the genus TEGANIUM. x 3.

Figure 16. Another group of young examples.

Figure 17. One of these enlarged, showing long peripheral spicules and a continuous surface film. x 3.

Figure 18. A normal mature specimen, natural size. This specimen is in the condition of preservation usual for this species, the sponge having separated in such a manner as to expose the inner poriferous wall of the reticulum, and the outer wall in peripheral section. The rest of the latter adheres to the separated portion of the matrix.

Figure 19. An enlargement of a portion of the inner wall, showing the areoles enclosed by a net-work of irregularly arranged cruciform spicules. x 3.

Figure 20. A portion of the outer wall of the sponge, showing a regular reticulation, the matrix beneath bearing obscure traces of the areoles of the inner layer. x 3.

Figure 21. An enlargement of a portion of the surface similar to that shown in figure 19. x 3.

Figure 22. Part of a segment of one of these spheres, showing a portion of the inner wall, and the section of the outer wall. x 3.

All the specimens here figured are from the Utica slate at *Holland Patent, New York.*

PLATE II.

HYDNOCERAS, Conrad.

Page 95.

(See Plates III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI)

HYDNOCERAS AVOCA, sp. nov.

Page 103.

(See Plates IX, X, XI.)

Figure 1. The upper portion of a large individual, an internal cast with very sharply defined reticulation; showing the broad, subcircular outline of the nodes.

Chemung group. *Avoca, New York.*

Figure 3. An incomplete and slender specimen with four horizontal rows of nodes, three of these being greatly extended.

Chemung group. *Jenks quarry, Bath, New York.*

HYDNOCERAS NODOSUM, Hall (sp.).

Page 109.

Figure 2. A view of a gutta-percha squeeze of the original impression; showing the small size of the species and its prominent nodes in at least five rows.

Chemung group. *Cattaraugus county, New York.*

HYDNOCERAS BOTRŒDEMA, sp. nov.

Page 102.

Figure 4. A specimen of average size, showing the extended, flattened and slightly drooping nodes, completely circular body and fine reticulation. This species is almost invariably found in a highly imperfect condition, and consequently, in this drawing the tips of the nodes have been somewhat restored from data furnished by several specimens.

Chemung group. *Irish hill, near Bath, New York.*

HYDNOCERAS TUBEROSUM, Conrad.

Page 97.

(See Plates III, IV, V, VI, VII, VIII, XXXVIII.)

Figure 5. View from the upper end of an average internal cast.

Figure 6. An enlargement of the surface of the internal cast.

Chemung group. *Brown hill, near Cohocton, New York.*

DICTYOSPONGIDÆ.

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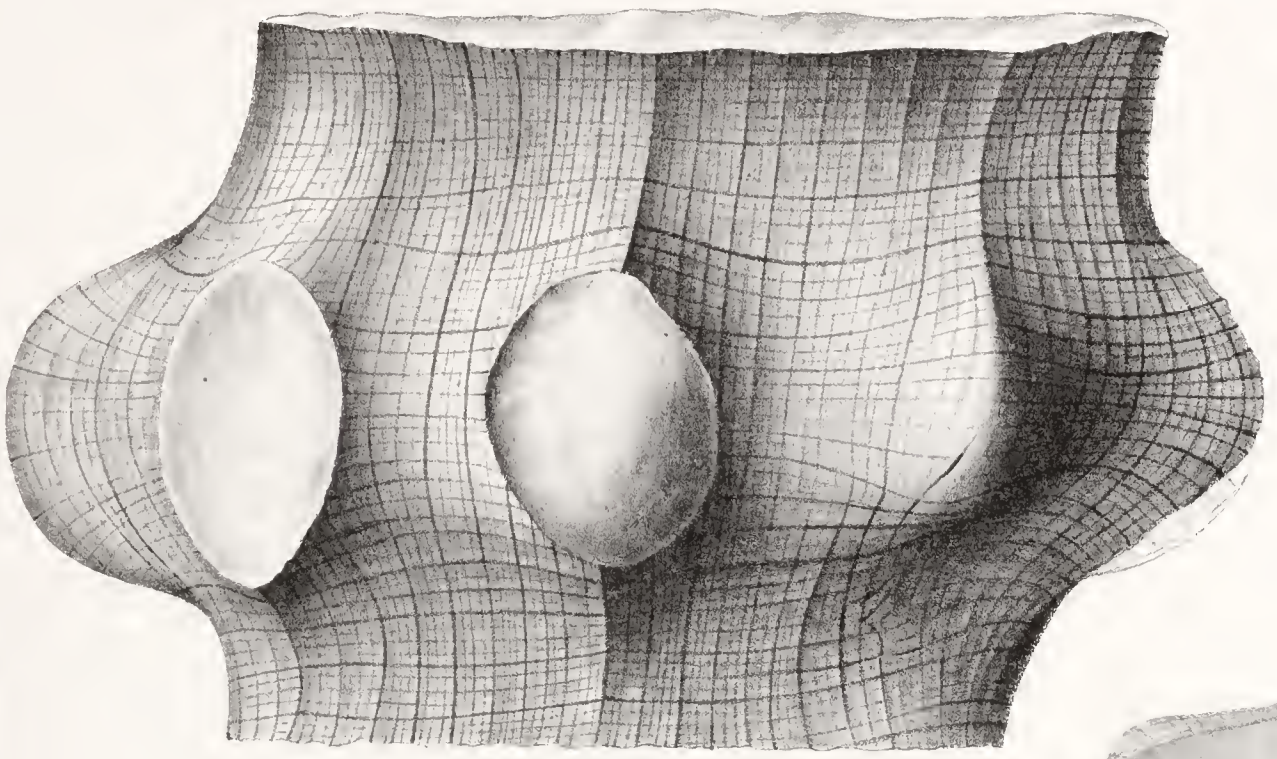

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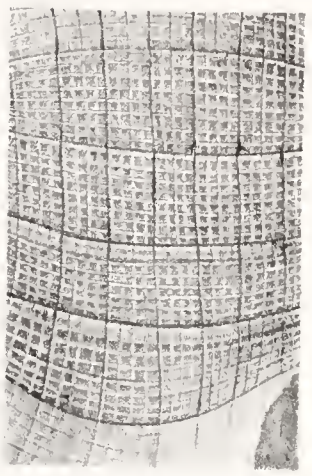

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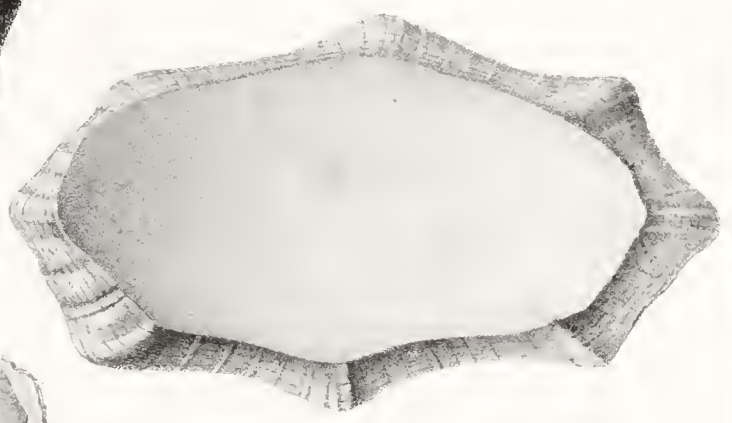

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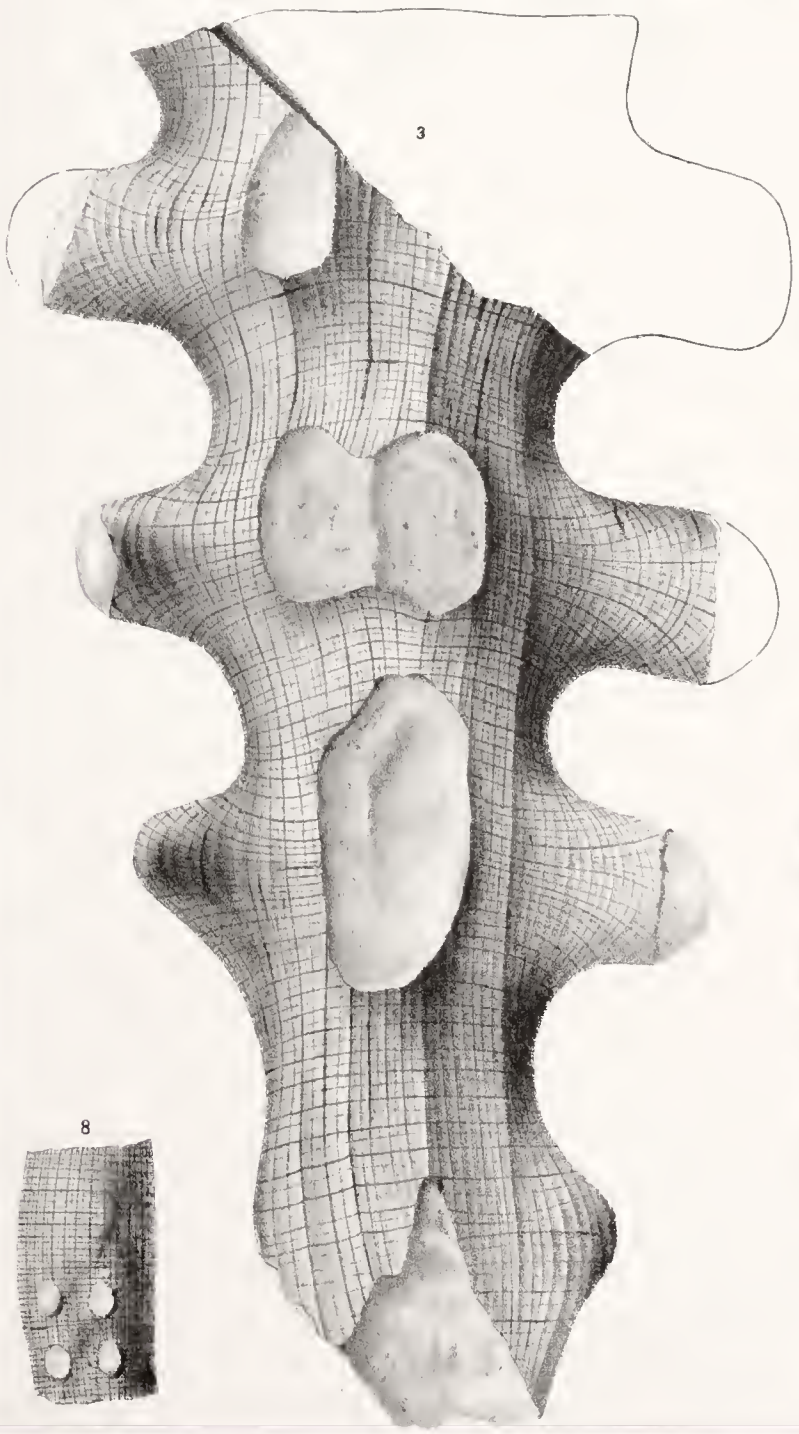

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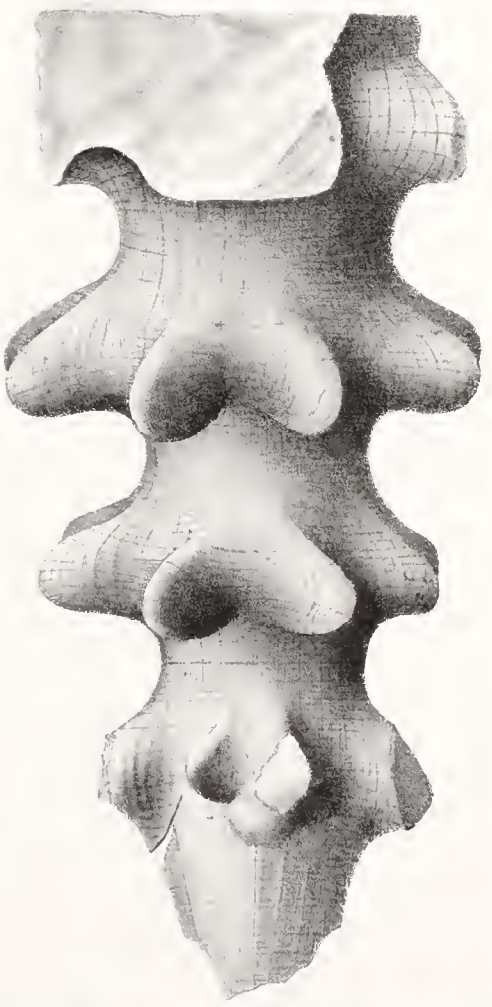

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Figure 7. A somewhat restored and conventional figure of this species, reproduced from the Thirty-fifth Annual Report of the N. Y. State Museum, pl. 17 (18), fig. 7.

HYDNOCERAS ANTHRACIS, sp. nov.

Page 109.

(See Plates VI and XXXIII.)

Figure 8. A fragment showing the upper portion of a small individual with fine reticulation, broad apertural surface and four low subcircular nodes.

Chemung group. *Wellsville, New York.*

PLATE III.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS TUBEROSUM, Conrad.

Page 97.

(See Plates II, IV, V, VI, VII, VIII, XXXVIII.)

Figure 1. The lower portion of a rather large individual in which the first horizontal row of nodes has developed with regularity, but the second and third rows have been disordered by the appearance of three nodes out of their normal position. It will be observed that owing to this malformation and a defect in the net-work near the center of the specimen, the vertical strands at the left of the drawing become continuous with and form the horizontal strands on the more remote node, lying next to the uppermost one on that side. This peculiar structure is very clearly shown on the specimen.

Figure 2. An incomplete specimen which has been somewhat compressed vertically and the depth of the horizontal constrictions thereby increased. The nodes have here, also, been somewhat irregular in their appearance, one in the third row occurring out of its vertical position, and its representative in the fourth row being omitted.

Figure 4. End view of a large specimen having but seven nodes.
Chemung group. *Brown hill, near Cohocton, New York.*

HYDNOCERAS BATHENSE, sp. nov.

Page 101.

(See Plates VIII and IX.)

Figure 3. An incomplete individual of average size, showing the prominent nodes.
Chemung group. *Jenks quarry, Bath, New York.*

DICTYOSPONGIDÆ.

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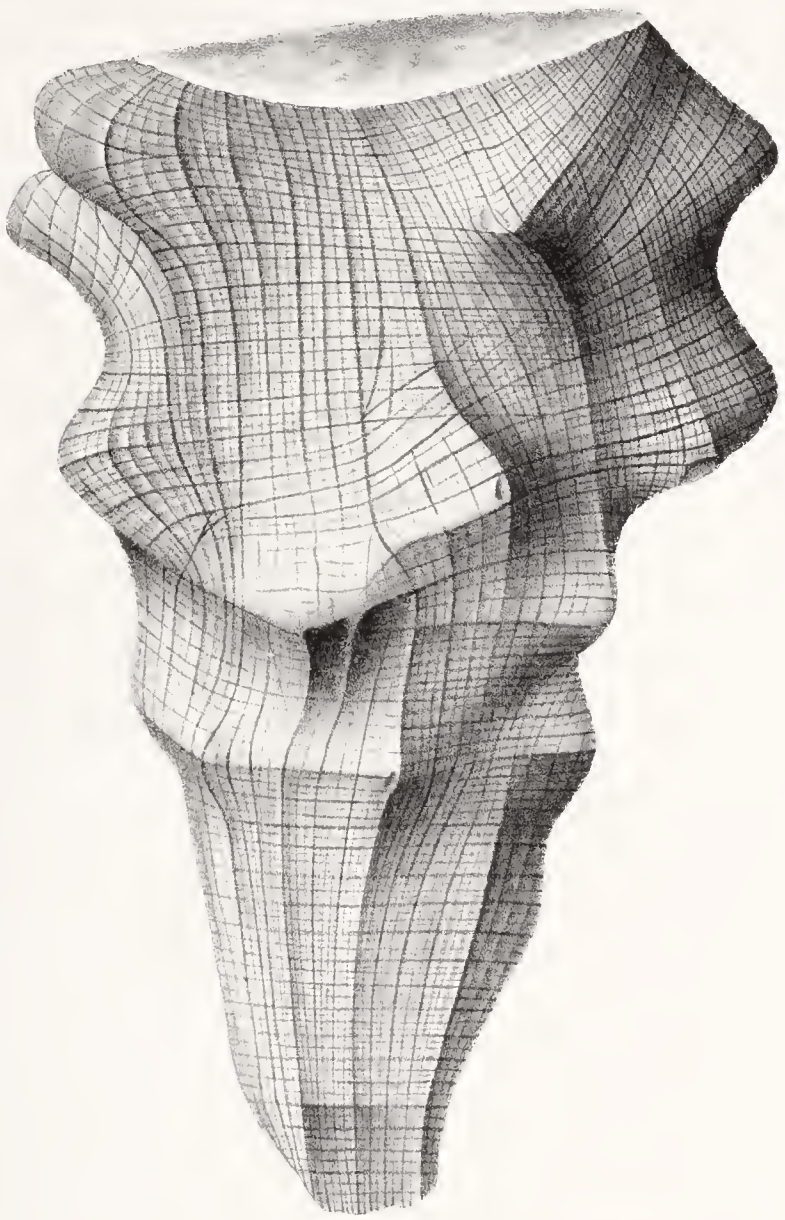

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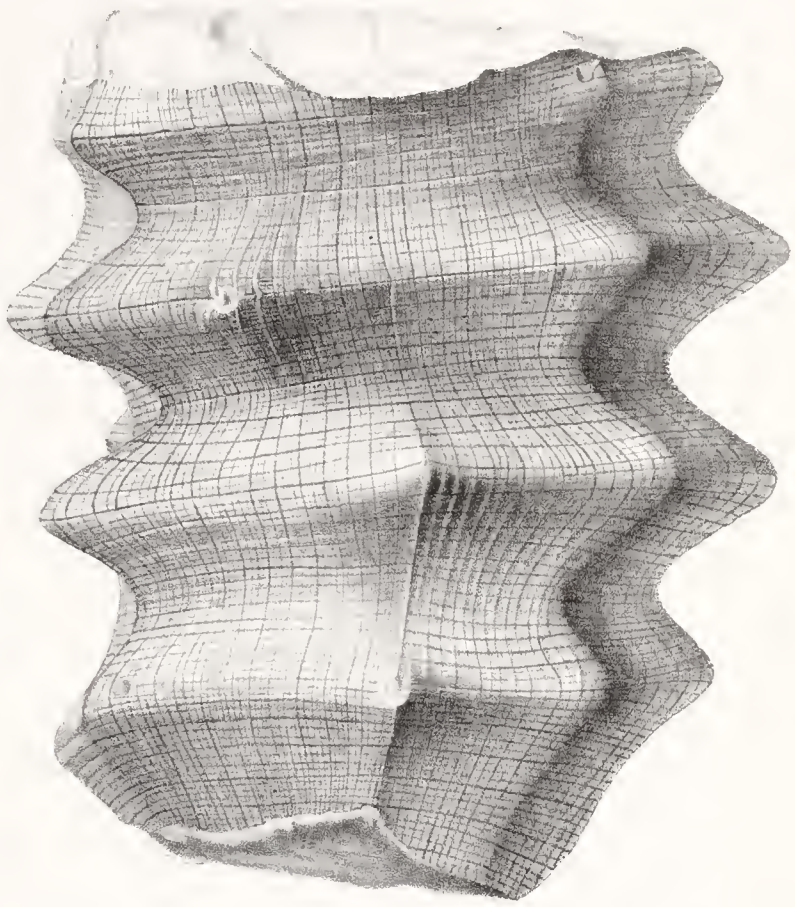

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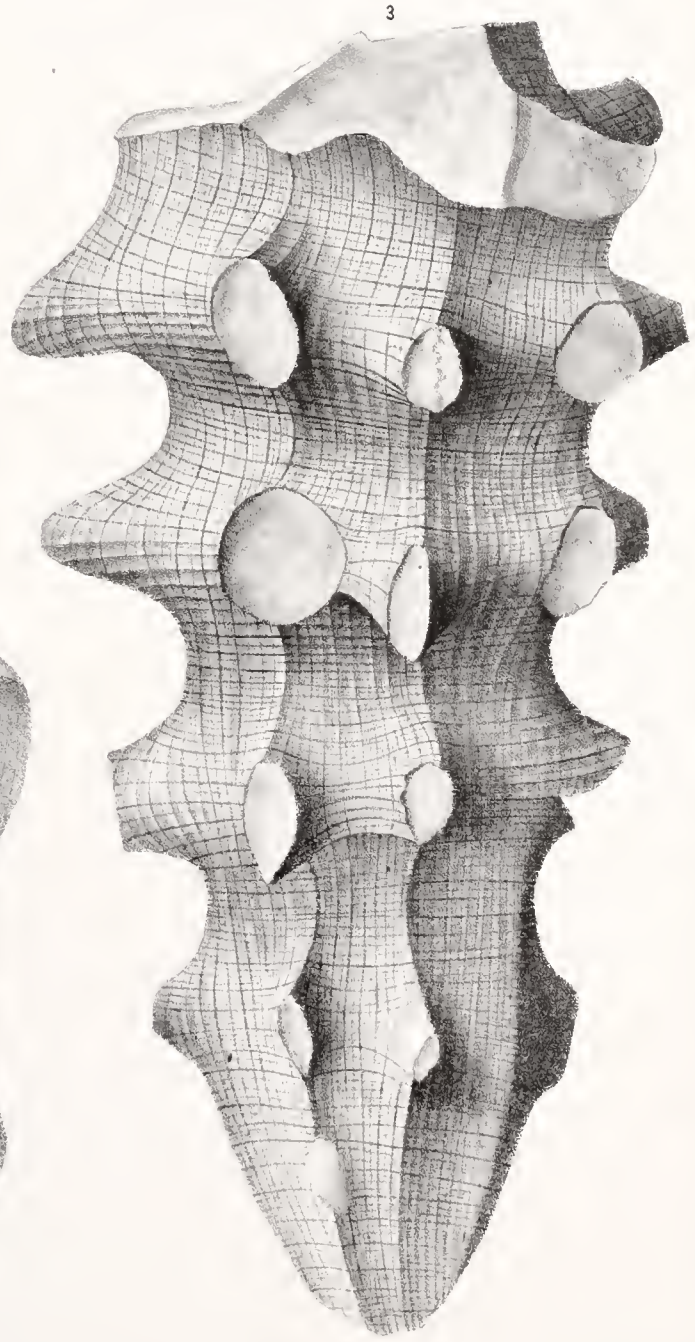

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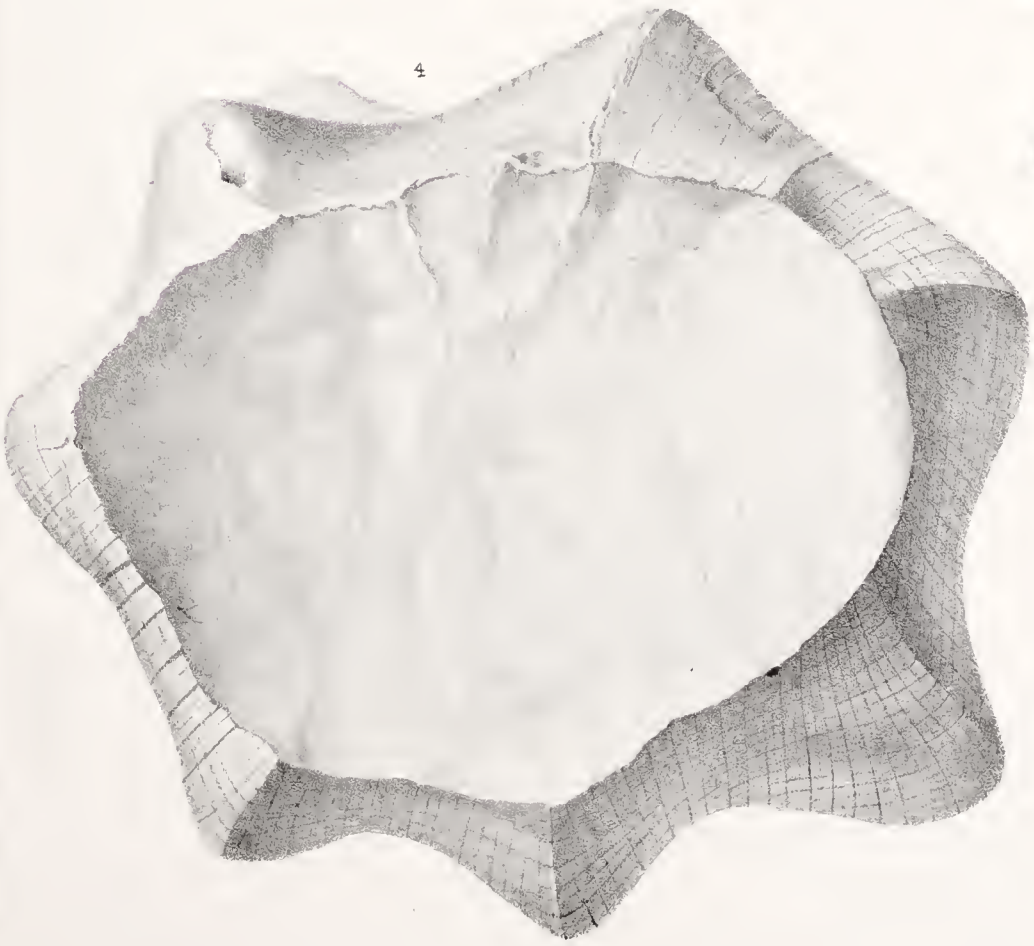

PLATE IV.

HYDRIODICTYA, gen. nov.

Page 77.

(See Plates V, XVI, XXI.)

HYDRIODICTYA PATULA, Hall (sp.).

Page 78.

Figure 1. A view of the original specimen; showing the smooth, expanding surface, regular aperture and sharply defined reticulation.
Chemung group. *Brown hill, near Cohocton, N. Y.*

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS TUBEROSUM, Conrad.

Page 97.

(See Plates II, III, V, VI, VII, VIII, XXXVIII.)

Figure 2. A plaster-cast of the original specimen of the species.
Chemung group. Said to have come from near *Addison, Steuben county, New York.*

Figure 3. A very broad and somewhat compressed example with the reticulation and subprismatic form finely preserved.

Figure 4. A small specimen with the normal number of four horizontal rows of low nodes, the summit of each of which is incomplete, indicating the presence of spicular tufts at these points. The specimen lies in its matrix, which retains the impressions of the pointed tufts on the lateral nodes and the vertical, erect expansions connecting them. These were probably also present in varying degrees of development on all of the principal vertical and horizontal spicular bands. An interesting abnormality is shown on the lower right margin of the specimen where a very strong spicular tuft exists between two nodes in their normal position, and there is only very obscure evidence of an intercalary node at this point. The tuft near the base of the sponge represents another very faintly developed node.
Chemung group. *Brown hill, near Cohocton, New York.*

DICTYOSPONGIDÆ.

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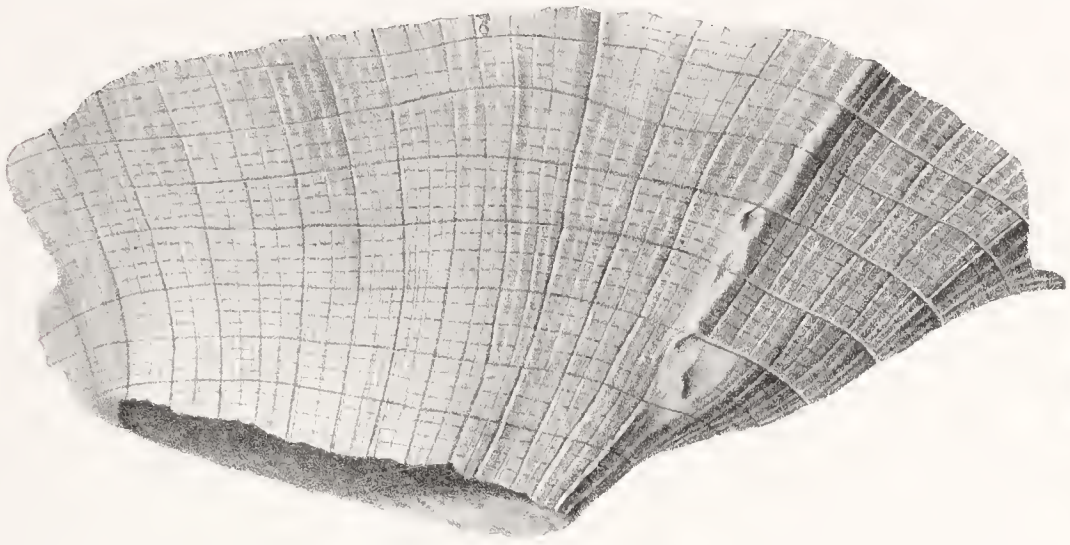

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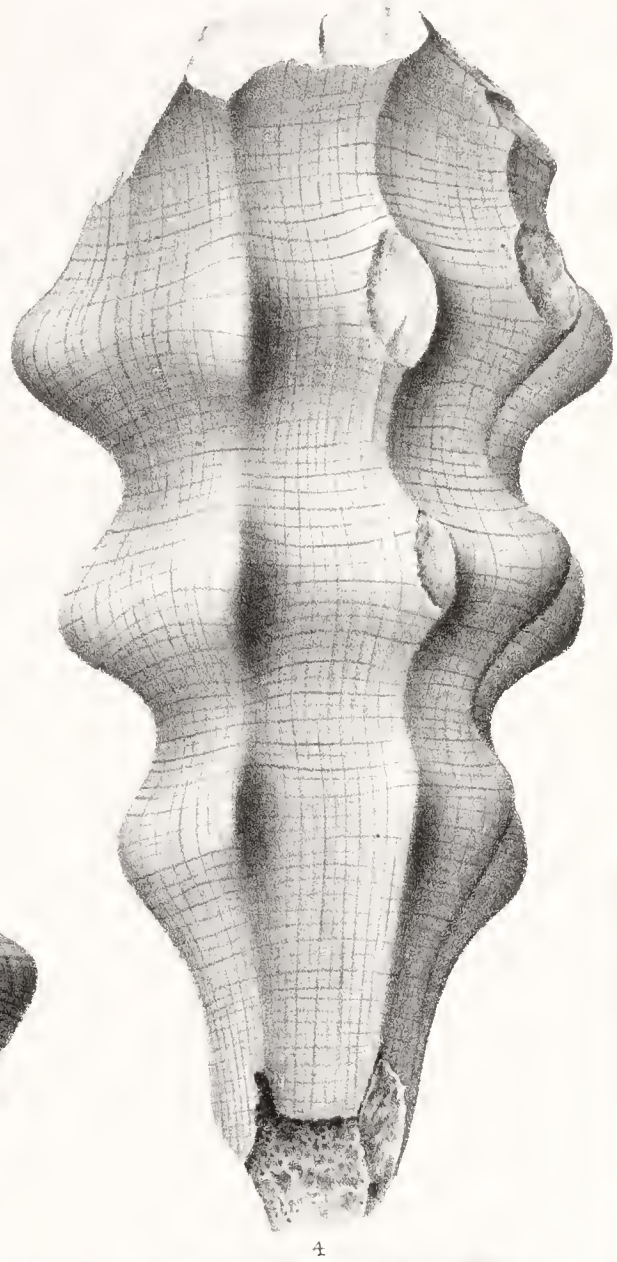

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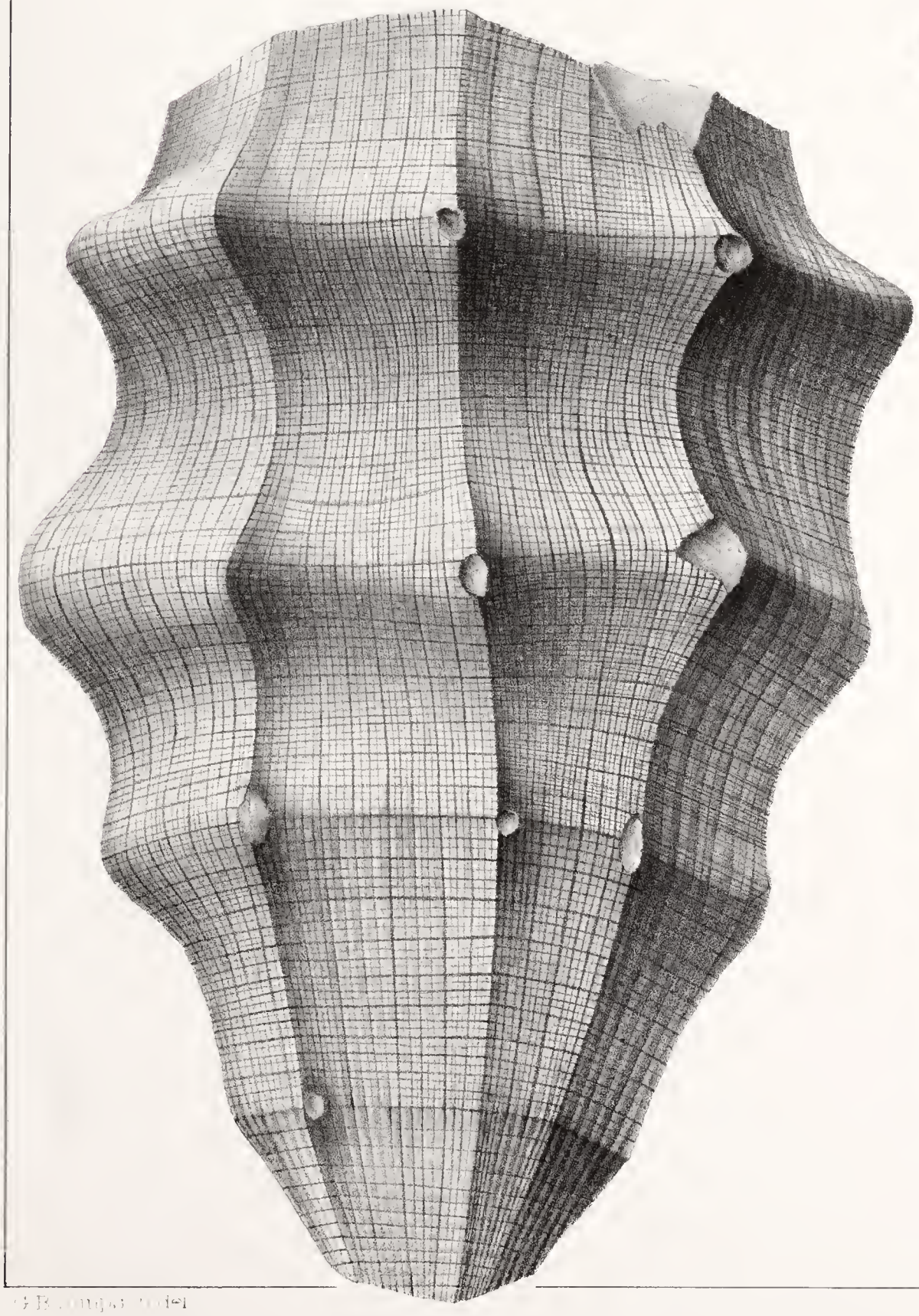

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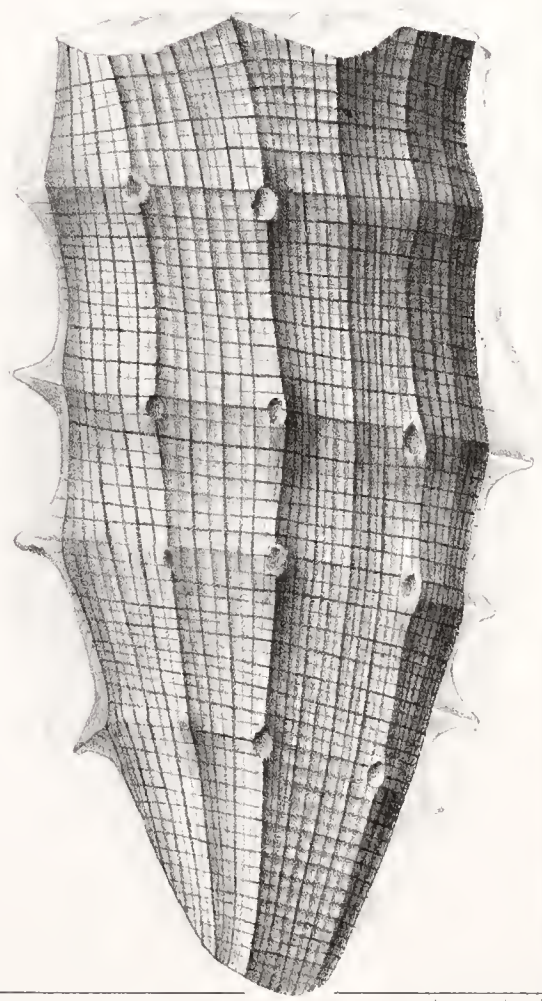


PLATE V.

HYDRIODICTYA, gen. nov.

Page 77.

(See Plates IV, XVI, XXI.)

HYDRIODICTYA CYLIX, sp. nov.

Page 78.

(See Plate XVI.)

Figures 1, 2. Opposite sides of a small, essentially entire specimen, showing the character of the reticulation. The surface of the sponge is smooth and the apparent swellings and depressions wholly due to compression in fossilization.

Chemung group. *Deyo basin, Naples, New York.*

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS TUBEROSUM, Conrad.

Page 97.

(See Plates II, III, IV, VI, VII, VIII, XXXVIII.)

Figure 3. A long, slender and nearly entire individual, bearing five horizontal rows of nodes with an additional one near the base in an incipient condition; showing the smooth surface in the apertural region, the regular aperture and the tufts at each node, which have been drawn in from impressions left upon the matrix.

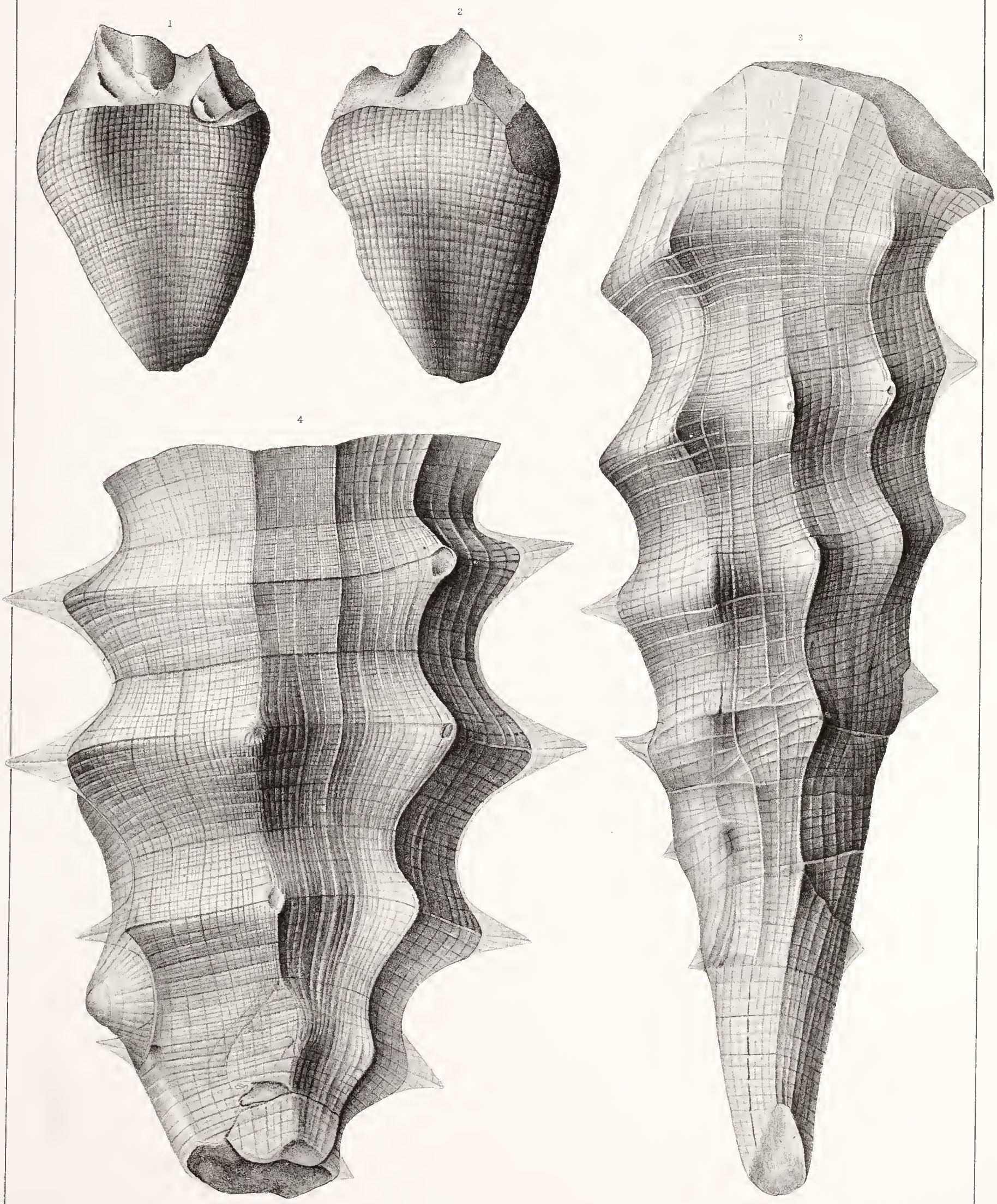
Figure 4. A stouter, more sharply prismatic specimen with more extended tufts, retaining also the vertical lamellae connecting them. The cavities left by the bases of these tufts are shown at the summits of some of the nodes.

Chemung group. *Brown hill, near Cohocton, New York.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate V



E. Emmons del

Philip Ast lith

PLATE VI.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS ANTHRACIS, sp. nov.

Page 109.

(See Plates II, XXXIII.)

Figure 1. A view of the upper portion of an individual, showing the small size of the species, its prismatic form, broad and smooth apertural surface and subcircular nodes. On the right of the specimen the extension of these nodes and their tufts into the matrix is shown.

Figure 2. The opposite side of the same specimen.

Chemung group. *Scio, New York.*

HYDNOCERAS TUBEROSUM, Conrad.

Page 97.

(See Plates II, III, IV, V, VII, VIII, XXXVIII.)

Figure 3. Two small individuals in a block of sandstone which retains impressions of the spicular tufts and lamellae.

Chemung group. *Brown hill, near Cohocton, New York.*

HYDNOCERAS PHYMATODES, sp. nov.

Page 104.

(See Plate XXXVII.)

Figures 4, 5. Opposite sides of a typical specimen having seven horizontal rows of low nodes; in the second and third rows there being eight nodes, in the fourth, nine, in the fifth and sixth, eleven. In the fifth horizontal row in figure 5, an intercalary node begins a new vertical row.

Chemung group. *Bath, New York.*

DICTYOSPONGIDÆ.

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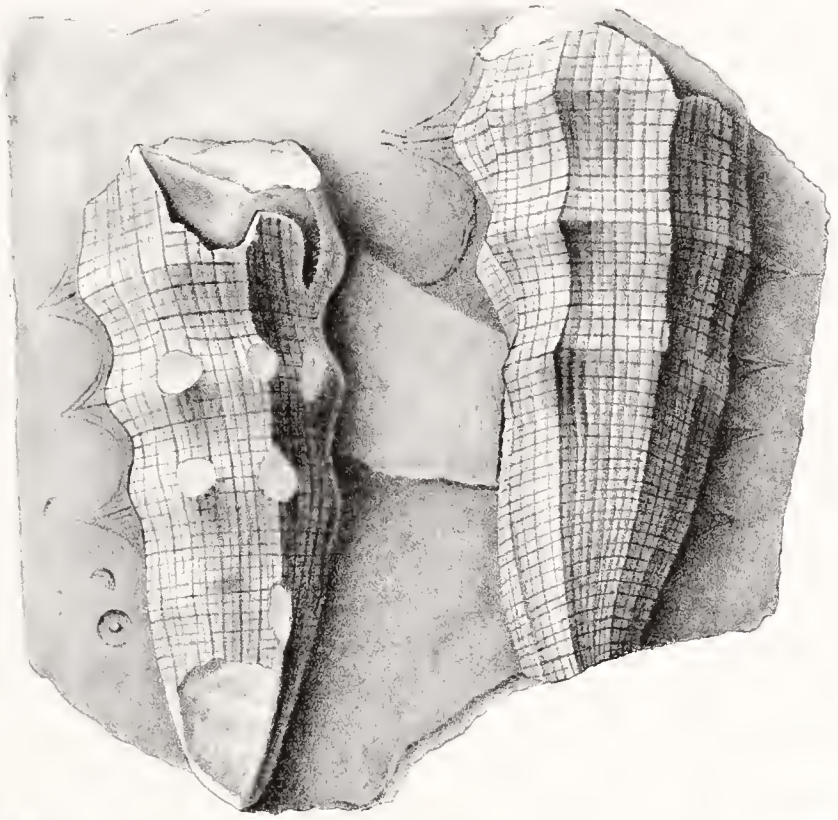

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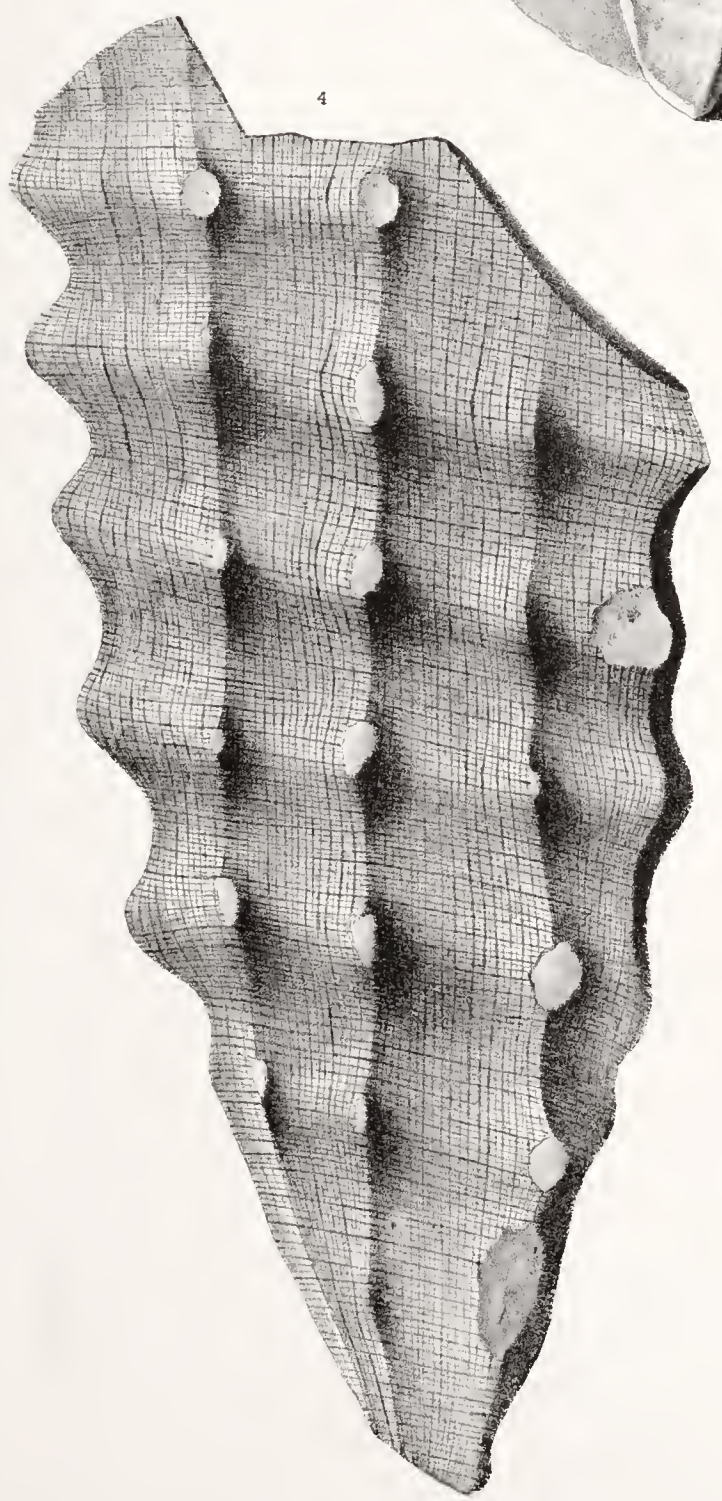

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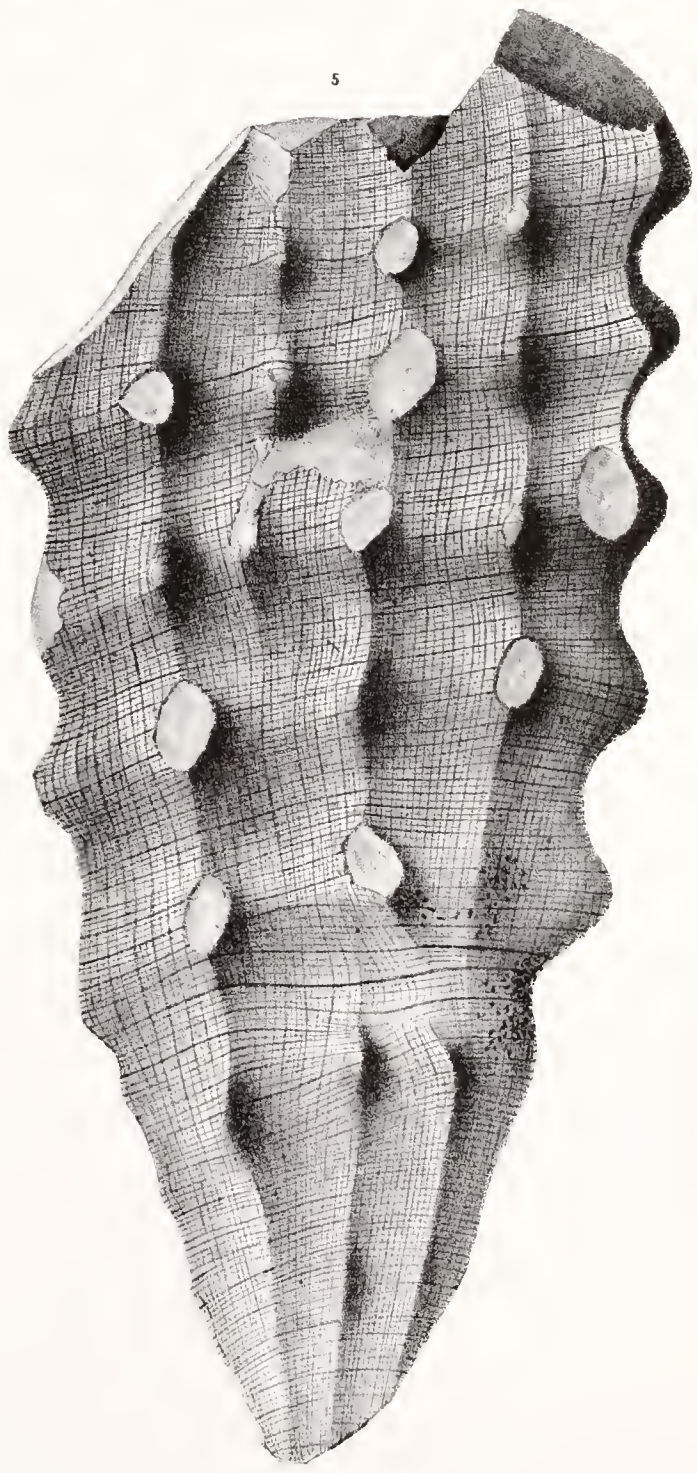

G B Simpson del

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PLATE VII.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS HYPASTRUM, sp. nov.

Page 105.

Figure 1. A transverse section viewed from beneath; showing the circular body of the species, and its strong, elongate pendant nodes arranged in pairs elevated on stout bases.

Chemung group. *Middle or southern part of Steuben county, New York.*

HYDNOCERAS TUBEROSUM, Conrad.

Page 97.

(See Plates II, III, IV, V, VI, VIII, XXXVIII.)

Figure 2. The basal portion of a small, nearly entire individual with low nodes and of irregular growth on one side; showing the abrupt appearance of an intercalary node near the top.

Figure 3. An entire specimen in which the growth has been interrupted, evidently by some accident, and the reticulum repaired, not however, without the disturbance and obliteration of most of the nodes. There is no actual break or tear in the reticulum as might be inferred from the appearance of the drawing near the top.

Chemung group. *Brown hill, near Cohocton, New York.*

HYDNOCERAS TUBEROSUM, Conrad, var. GLOSSEMA, var. nov.

Page 101.

(See Plate IX.)

Figures 4, 5. Opposite sides of a nearly entire example, having a very slender form and six horizontal rows of sharp nodes which have been made to appear rather too broad at the lateral margins.

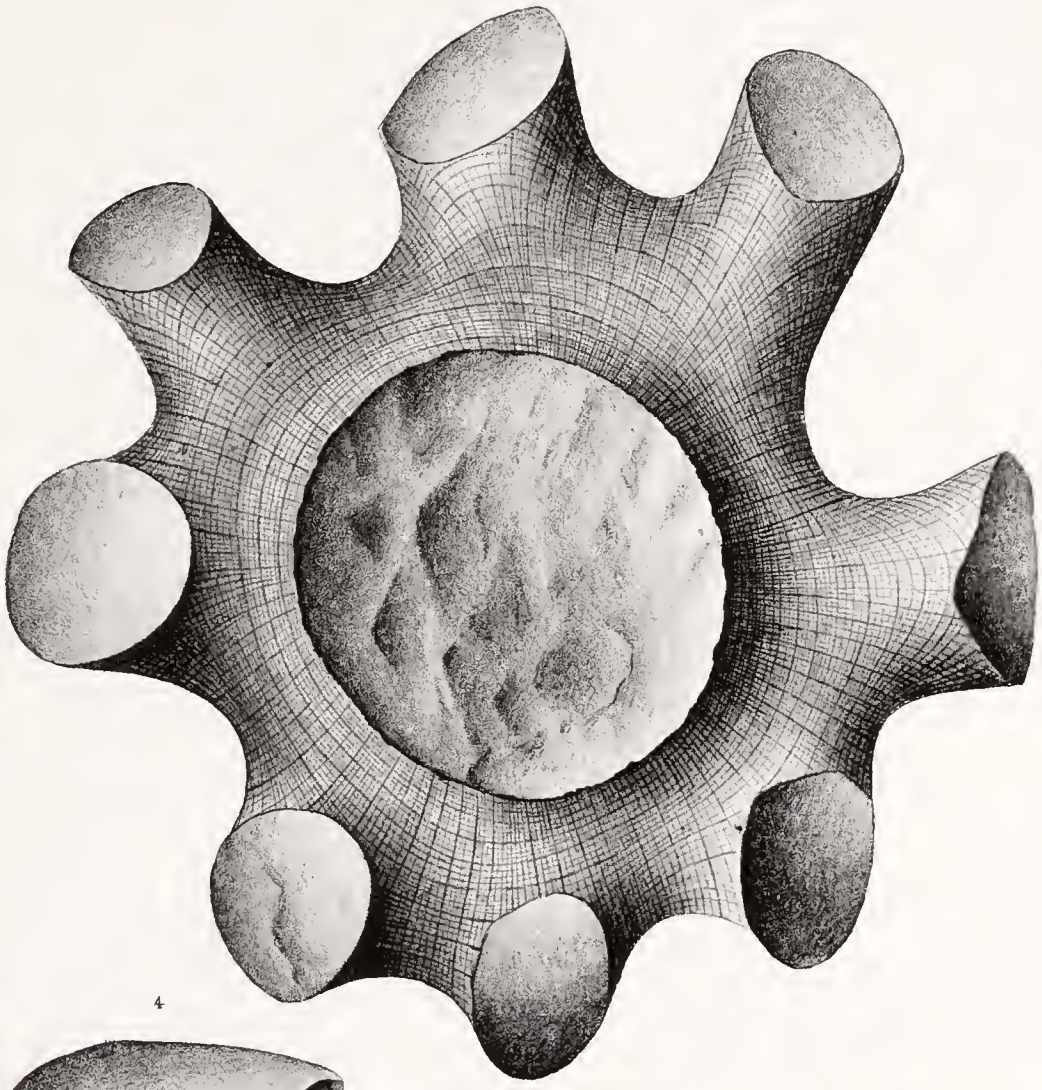
Chemung group. *Southwestern New York (exact locality uncertain).*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate VII

1



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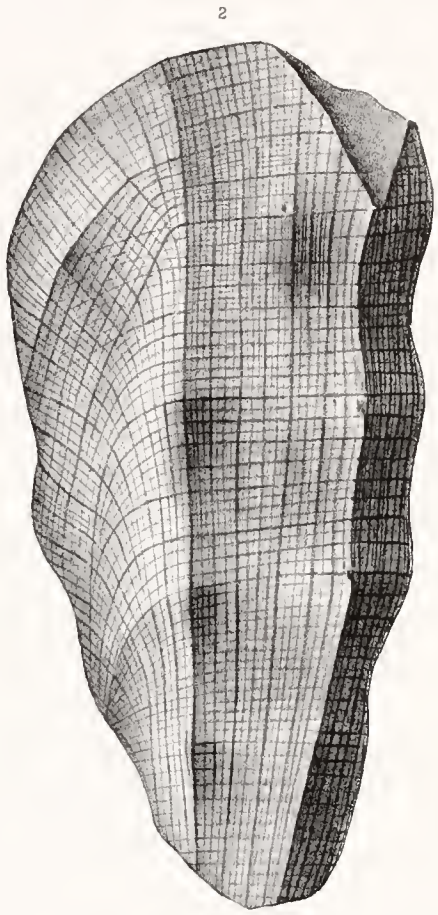

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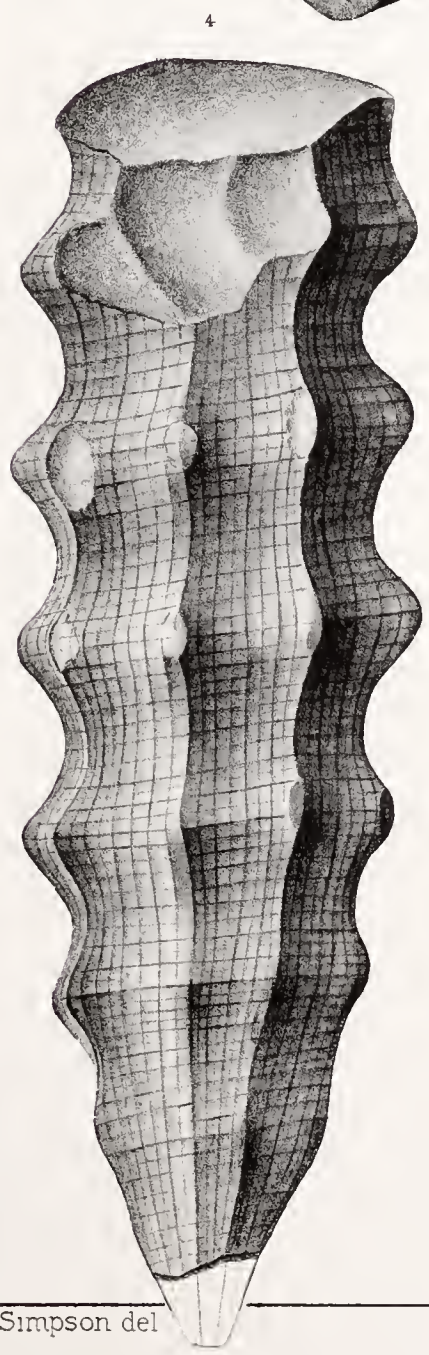

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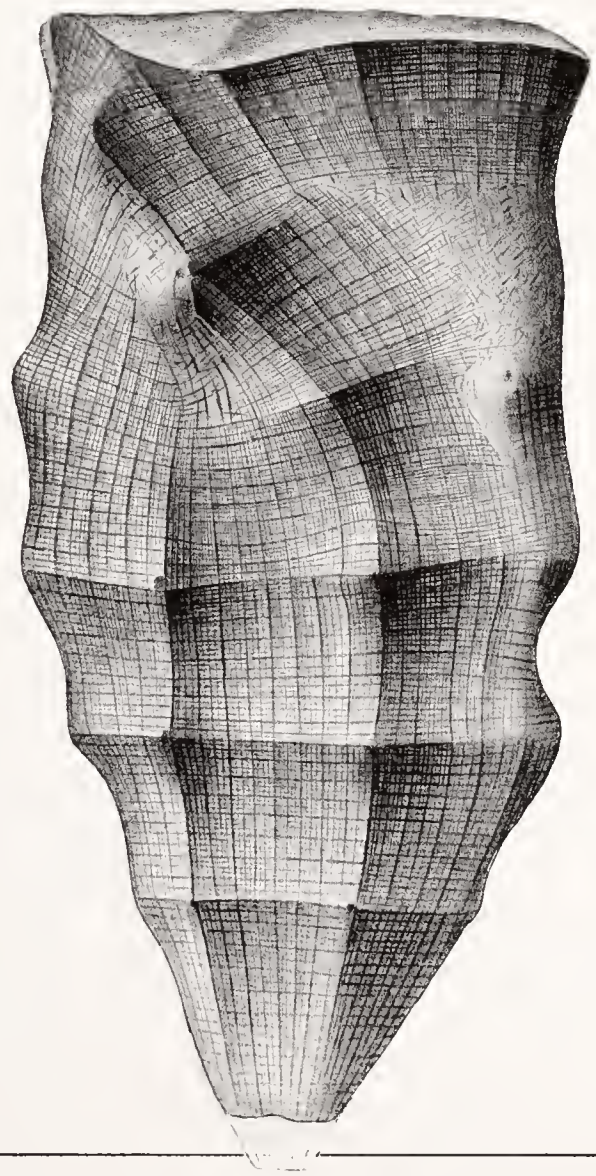

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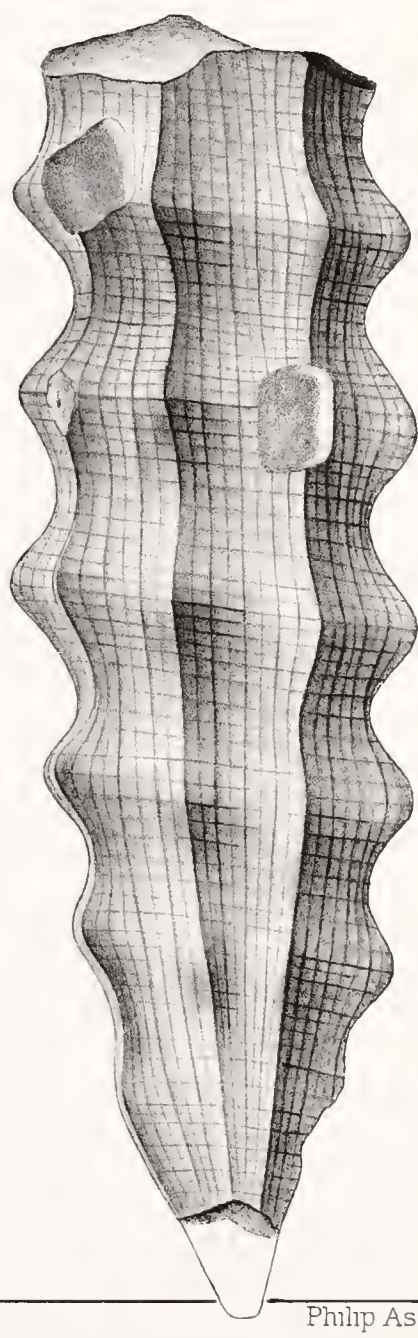


G.B Simpson del

Philip Ast lith

PLATE VIII.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII XXXIX, XLVI.)

HYDNOCERAS TUBEROSUM, Conrad.

Page 97.

(See Plates II, III, IV, V, VI, VII, XXXVIII.)

Figure 1. The basal extremity of a large individual, showing the very obscure nodes and sharply defined prism-faces.

Figure 2. A nearly entire individual with four well defined horizontal rows of low and sharp nodes, and broad, gently and regularly expanded apertural region bearing only two small nodes belonging to the median vertical series. Near the apex of the specimen the prismatic faces are more obscure than elsewhere.

Chemung group. *Brown hill, near Cohocton, New York.*

HYDNOCERAS sp.

Page 111.

Figure 3. An imperfect and irregular fragment representing a moderately large undescribed species of this genus, from an horizon where such forms are of very rare occurrence.

Chemung group. *Wellsville, New York.*

HYDNOCERAS BATHENSE, sp. nov.

Page 101.

(See Plates III and IX.)

Figure 4. A nearly entire example, with four horizontal rows of strong nodes; showing the fine reticulation of the surface and the obsolescence of the prismatic faces.

Chemung group. *Jenks quarry, Bath, New York.*

HYDNOCERAS EUTHELES, sp. nov.

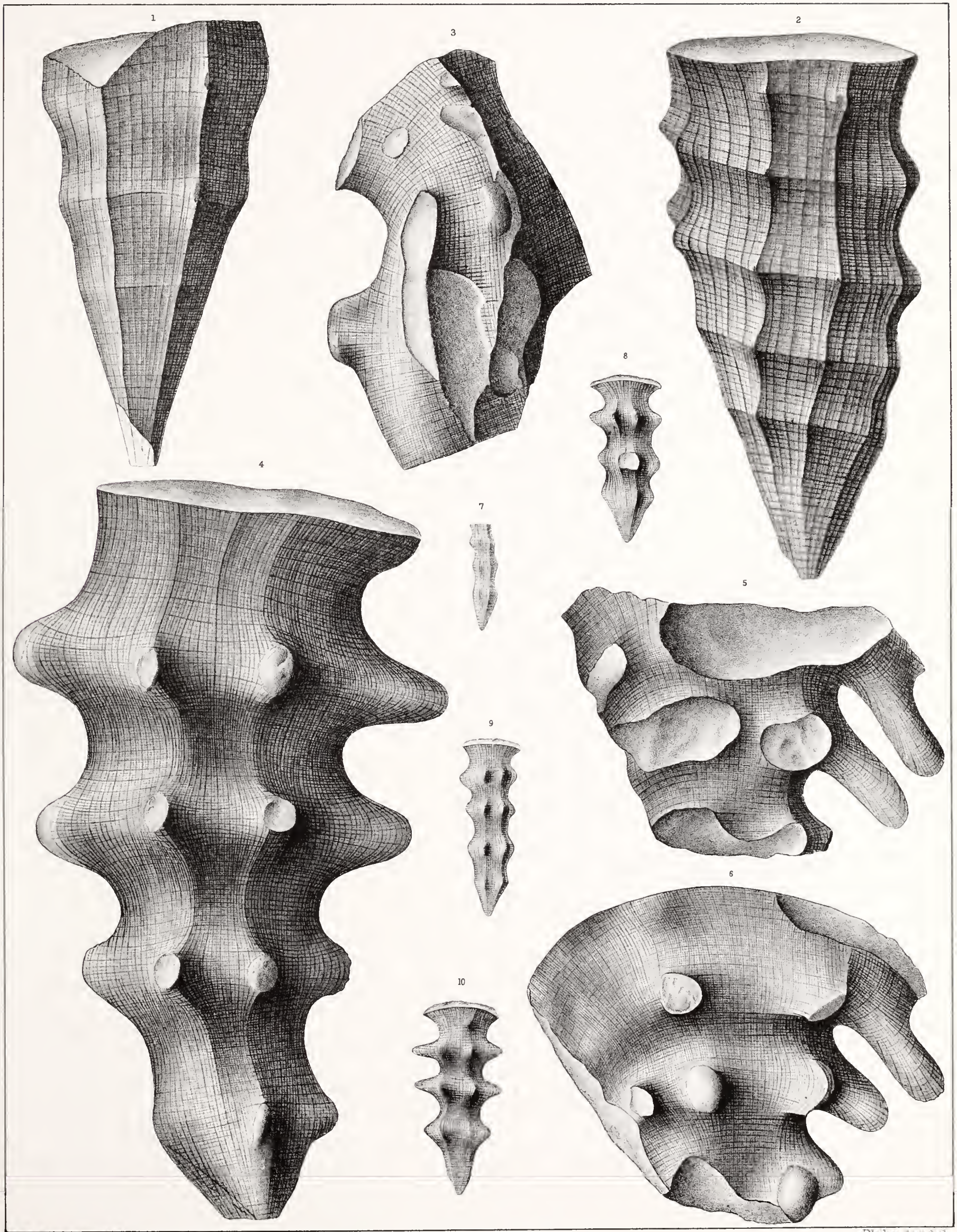
Page 105.

(See Plate XXXIII.)

Figures 5, 6. Two fragments representing like parts of two individuals and showing the broad form of the sponge and the narrow, extended and drooping nodes.

Chemung group. *Cotton hill, near Avoca, New York.*

DICTYOSPONGIDÆ.



Hydnoceras Luthieri, sp. nov.

Page 106.

Figure 7. A young and slender specimen with low nodes.

Figure 8. An entire individual with three well developed rows of nodes and entire aperture.

Figure 9. A mature individual with four horizontal rows of nodes.

Figure 10. A full-grown example with strong nodes in three rows and an accessory node in the apertural region.

Chemung group. *Segur's gully, Italy, Yates county, New York.*

PLATE IX.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, VIII, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS BATHENSE, sp. nov.

Page 101.

(See Plates III, VIII.)

Figure 1. A large, somewhat incomplete individual with six rows of strong rounded nodes, showing some interesting peculiarities of development. In the fourth row one node, instead of appearing at its proper place, stands at the middle of the prism-face, and in the fifth row the node of a different vertical series is wanting, while in the sixth row, so far as it is preserved, there is but a single well defined node. Chemung group. *Jenks quarry, Bath, New York.*

HYDNOCERAS TUBEROSUM, Conrad, var. GLOSSEMA, var. nov.

Page 101.

(See Plate VII.)

Figure 2. In this example there is a considerable area at the base, where an incipient row of nodes is represented only by a series of broad swellings at the prism-angles. Three horizontal rows are well developed, and in the apertural region is evidence of another row of smaller nodes. The two lower rows (not including the incipient row near the base) have seven nodes, while that immediately above has eight, the eighth vertical row appearing abruptly, as shown in the figure. The reticulation is sharply defined, but not finely divided. The surface shows impressions of worm-like markings which, as elsewhere suggested, may be the tube of some commensal annelid.
Chemung group. *Southwestern New York (exact locality unknown).*

HYDNOCERAS AVOCA, sp. nov.

Page 103.

(See Plates II, X, XI.)

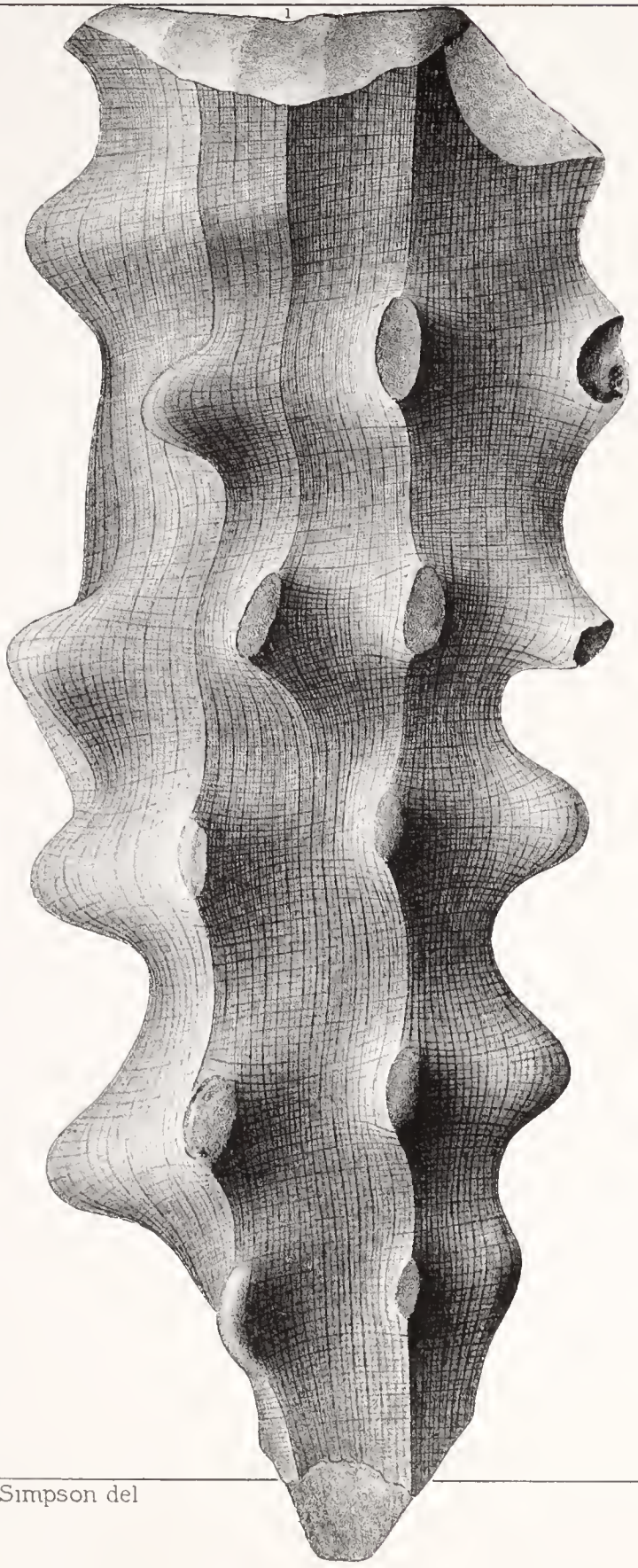
Figure 3. An imperfect example with three fully developed horizontal rows of large and short nodes with subsemicircular marginal outline, and an inceptive basal row. The prismatic faces are obscured, except over the basal region, and the horizontal constrictions are deep and narrow.
Chemung group. *Near Avoca, New York.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate IX

1



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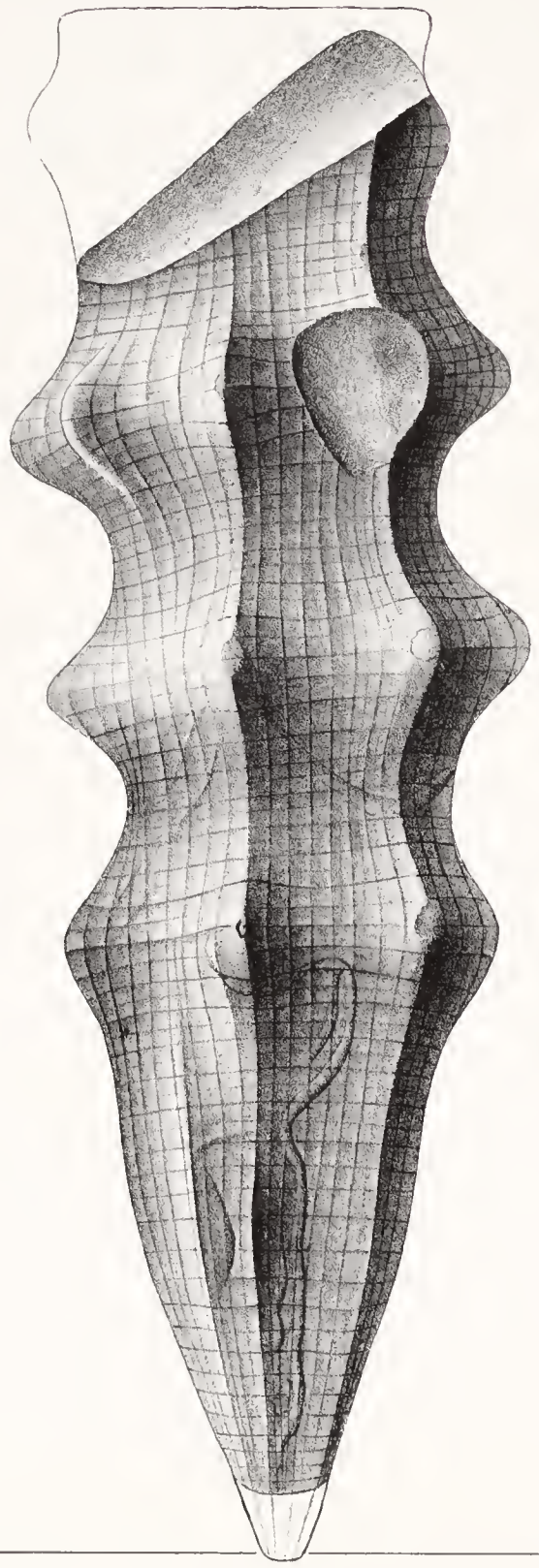

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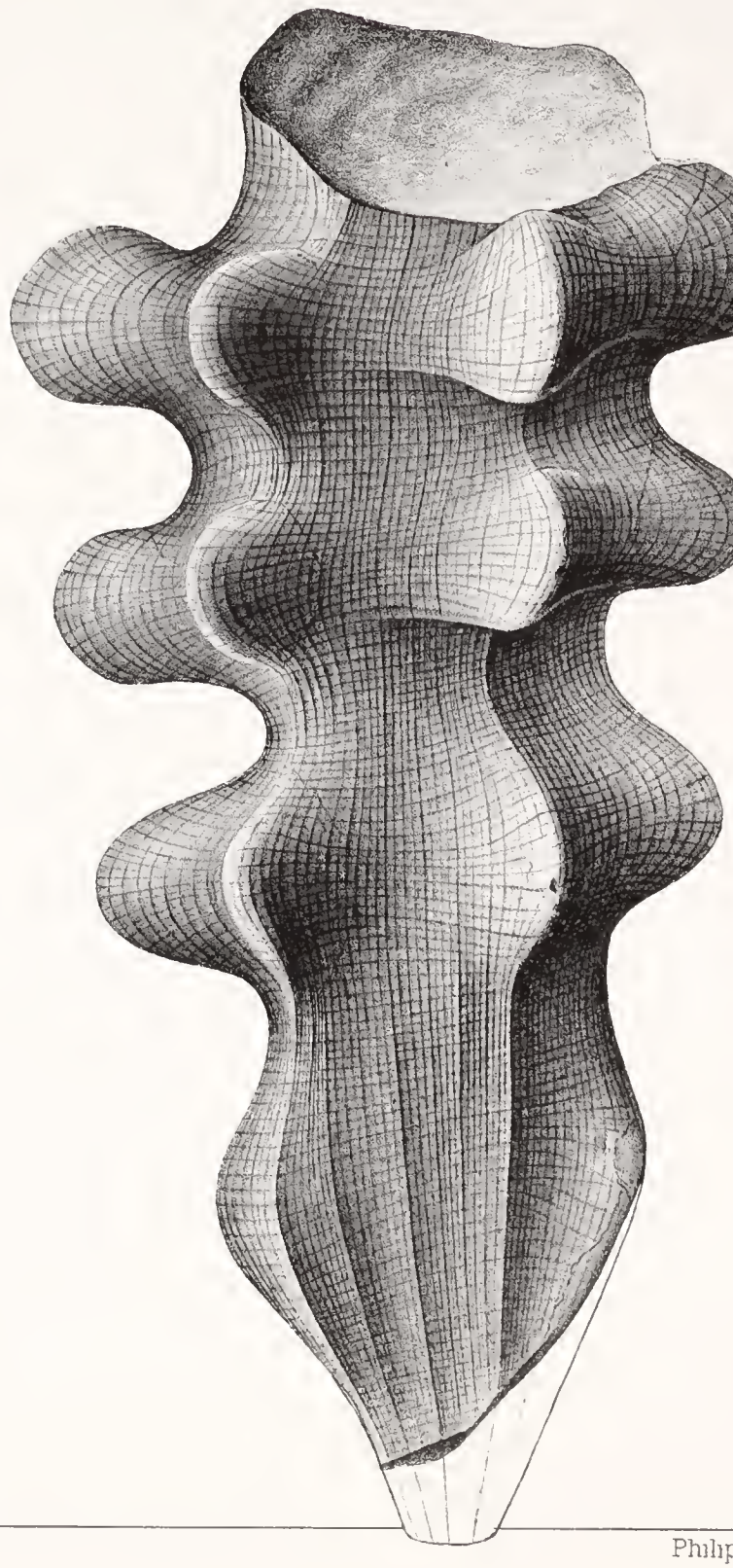

G.B Simpson del

Philip Ast lith

PLATE X.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, VIII, IX, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS AVOCA, sp. nov.

Page 103.

(See Plates II, IX, XI.)

Figure 1. A large, somewhat incomplete example with five horizontal rows of fully developed nodes and an incipient row near the base. This specimen shows the great size of the nodes, their semielliptical or semicircular outline and the deep and narrow horizontal constrictions by which they are separated.

Chemung group. *Near Avoca, New York.*

Memoirs Geological Survey of New York

1

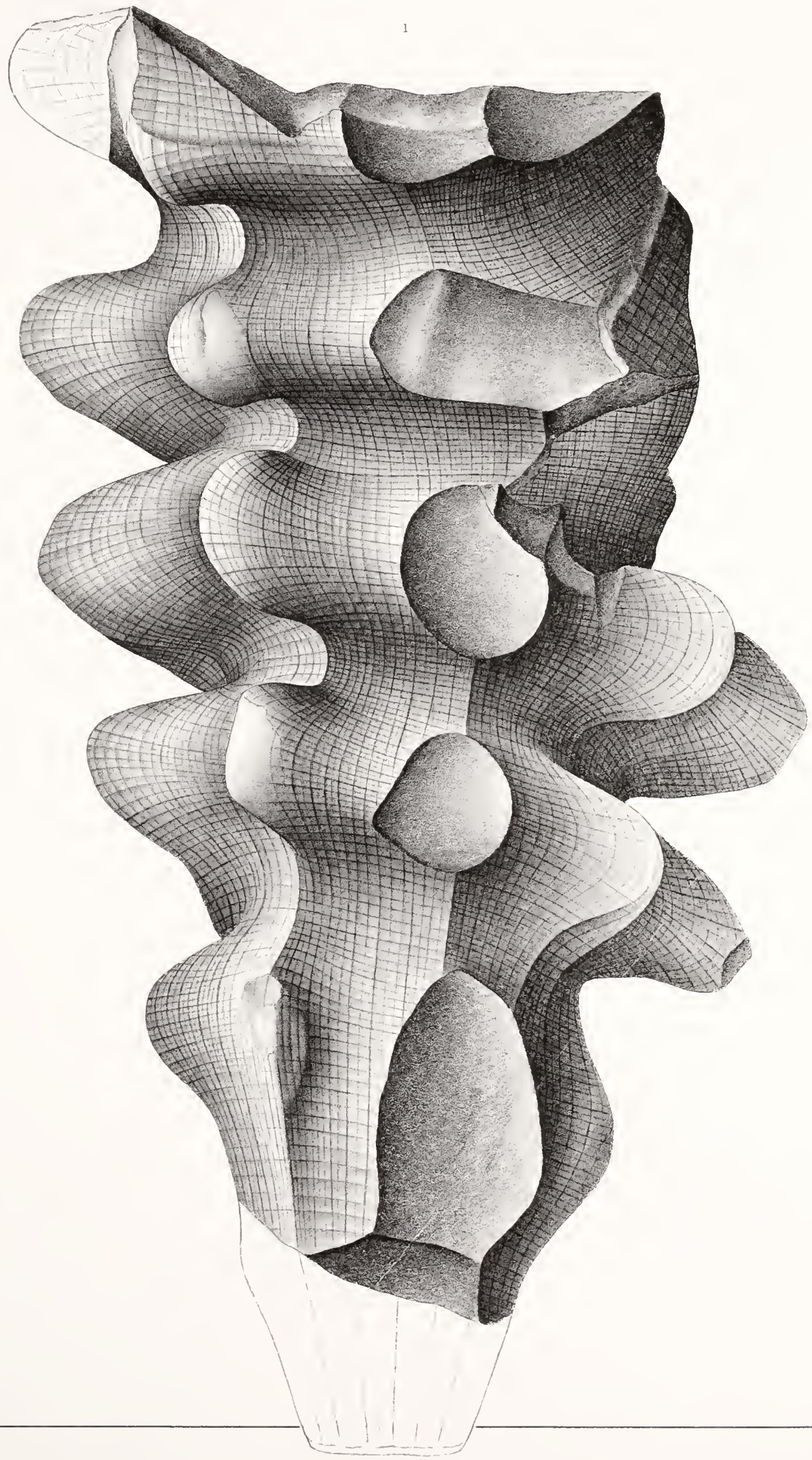

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PLATE XI.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

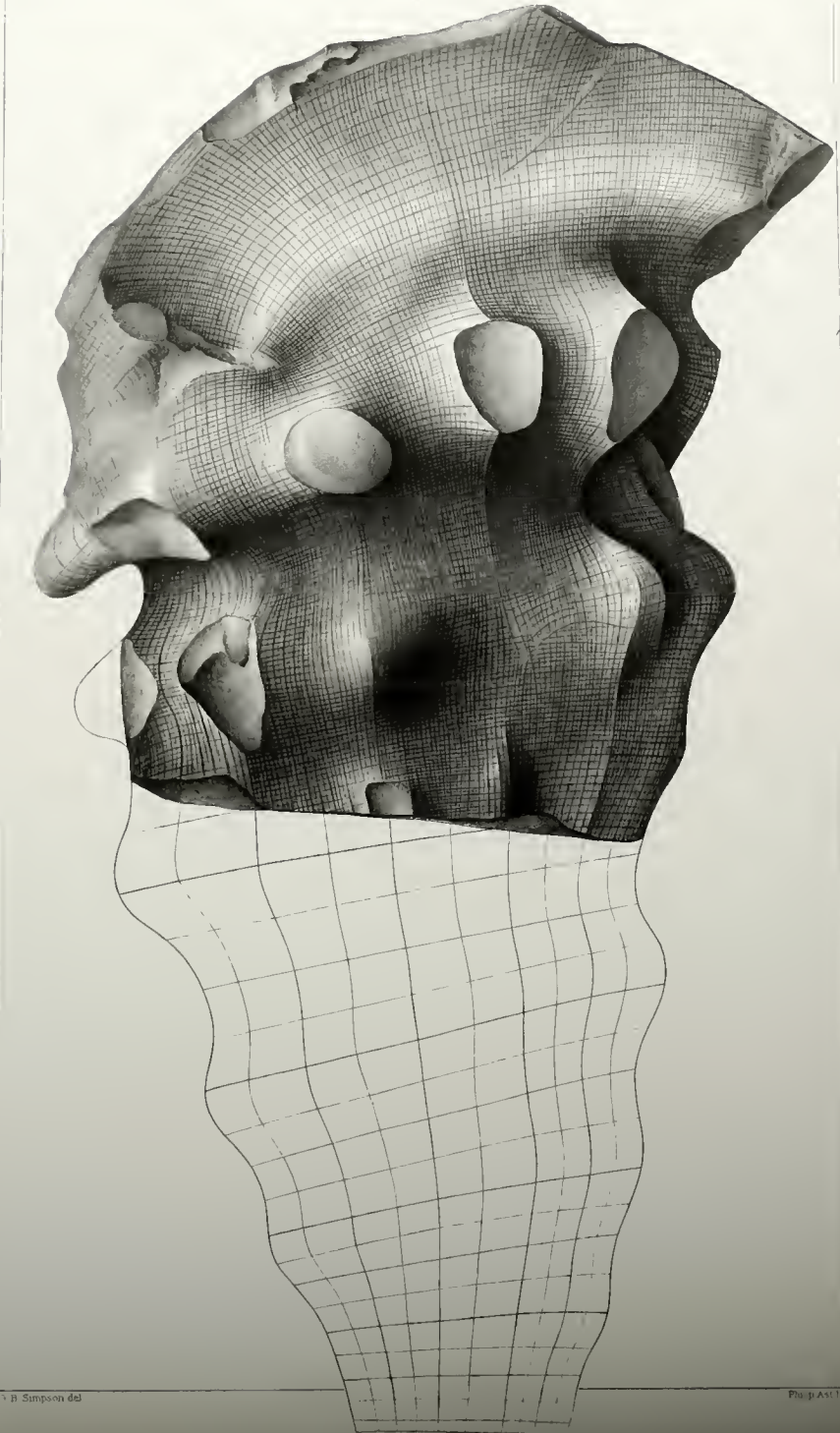
HYDNOCERAS AVOCA, sp. nov.

Page 103.

(See Plates II, IX and X.)

Figure 1. This specimen represents the apertural and upper portion of a gigantic individual of this species, whose probable original proportions are partially restored in outline. The sponge is somewhat irregularly compressed, and the nodes upon its surface have been flattened without destroying their characteristic expression in this species. The specimen was taken from the foundation wall of an old mill at Avoca, and its exact locality is not known, though doubtless from the beds in that vicinity which have produced most of the known examples of this species.

Chemung group. *Avoca, New York.*



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Philip Ast lith

PLATE XII.

HYDNOCERAS, Conrad.

Page 95.

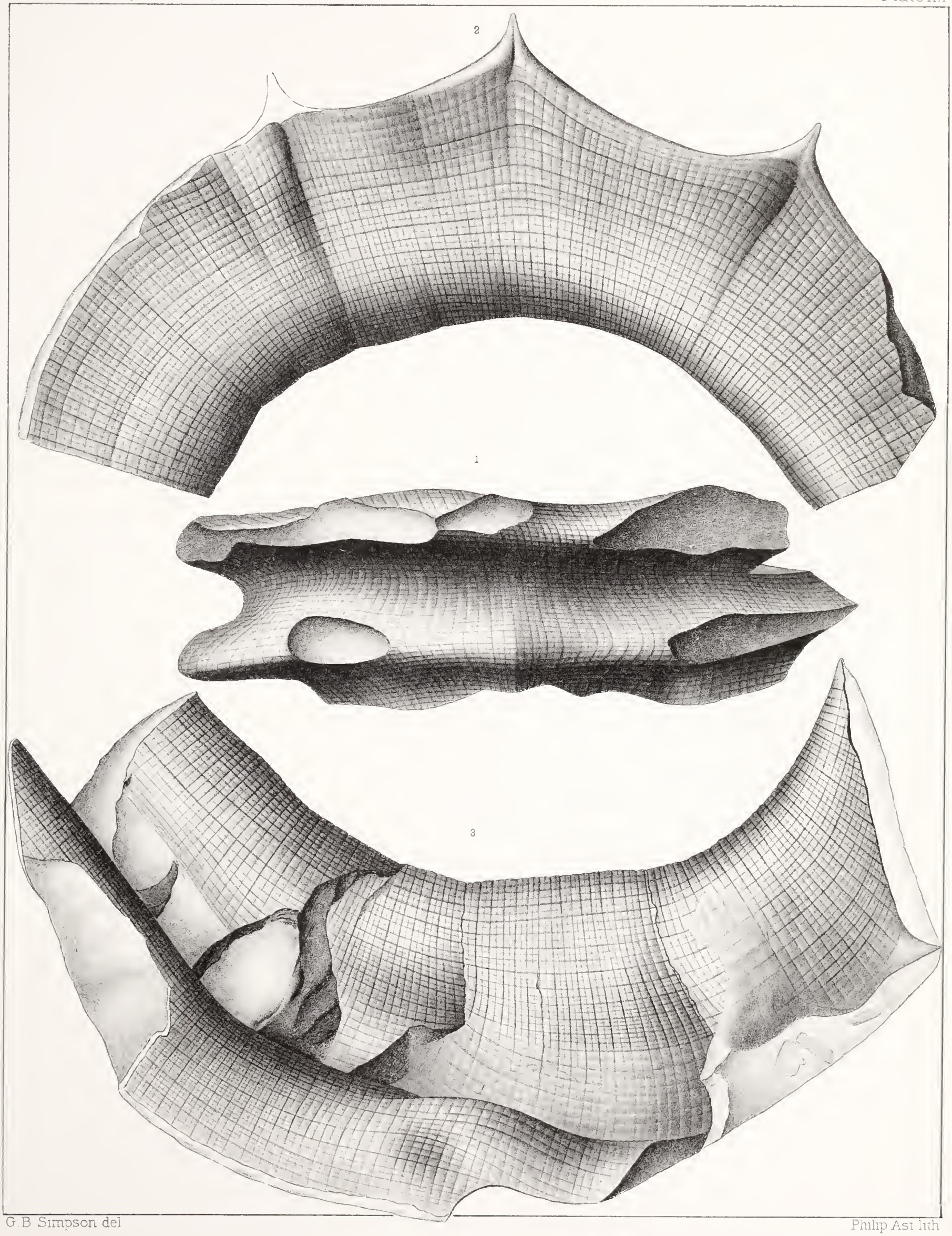
(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS EUMECES, sp. nov.

Page 110.

Figures 1, 2, 3. Three fragments of one specimen which consists of a large cup greatly compressed along the vertical axis. Figure 1 shows a portion of the internal cast, figures 2 and 3 impressions of the exterior, indicating the depth of the horizontal constrictions, and showing the sharp, tufted nodes and the character of the reticulation. Chemung group. *Alfred, New York.*

DICTYOSPONGIDÆ.



G.B. Simpson del

Philip Ast lith

PLATE XIII.

BOTRYODICTYA, gen. nov.

Page 111.

BOTRYODICTYA RAMOSA, Lesquereux (sp.).

Page 111.

Figure 1. A compressed and imperfect specimen showing the three rows of compound nodes and the single row of simple nodes in the apertural region. These nodes have all been much flattened and considerably distorted. The pedicel is partially retained.

Figure 2 A transverse section of a specimen showing a portion of the apertural nodes in their normal extent and form.

Figure 3. The other side of the specimen represented in figure 1.

Figure 4. A laterally compressed specimen viewed from the base of the cup, showing the outward extent of the nodes.

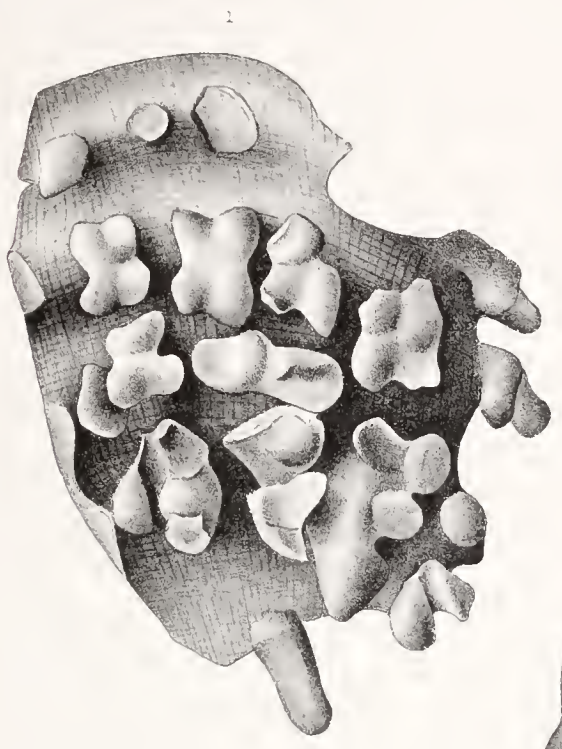
Figure 5. An apical view of a gutta-percha cast taken from the interior of the base of the cup; showing that the vertical bands of the cup converge to an apex and form a distinct internal reticular wall or diaphragm at this plane.

Figure 6. A specimen having an unusually large vase and slender pedicel. This example shows the obsolescence of the prismatic faces, the erect, bilobed or simple subapertural nodes and the pendulous compound nodes of the lower rows.

Figure 7. The opposite side of the same individual, only a portion of the surface and lobes being exposed, more below than above. The erect node at the summit is apparently a division of one of the apertural nodes.

Figure 8. The most complete individual obtained; showing the form of the cup and its nodes, and a portion of the long, smooth reticulate pedicel. Chemung group. *Lawrenceville, Tioga county, Pennsylvania.*

DICTYOSPONGIDÆ.



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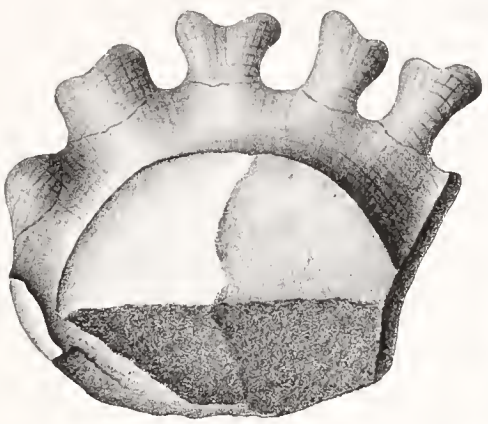

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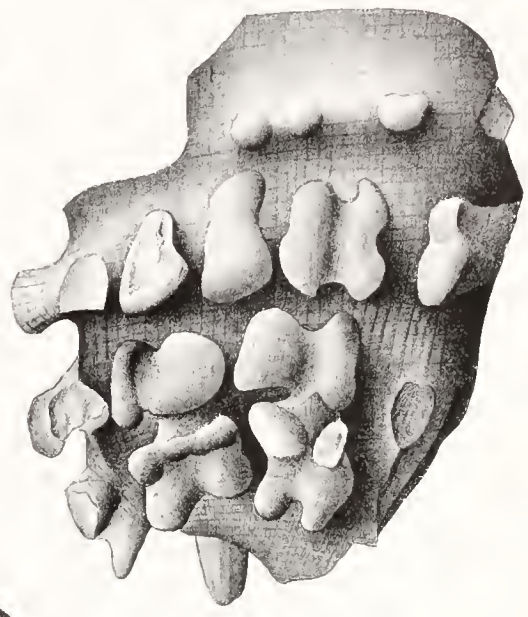

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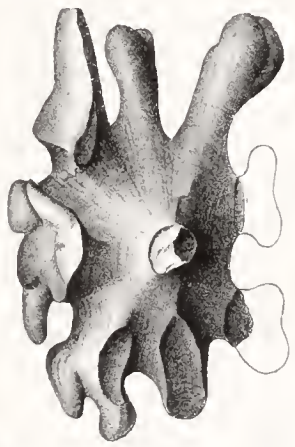

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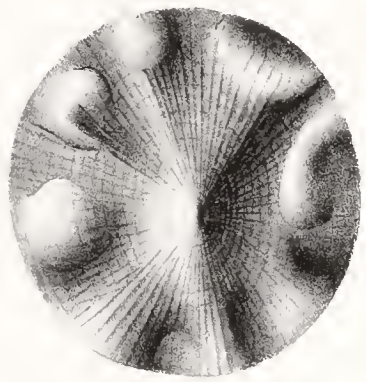

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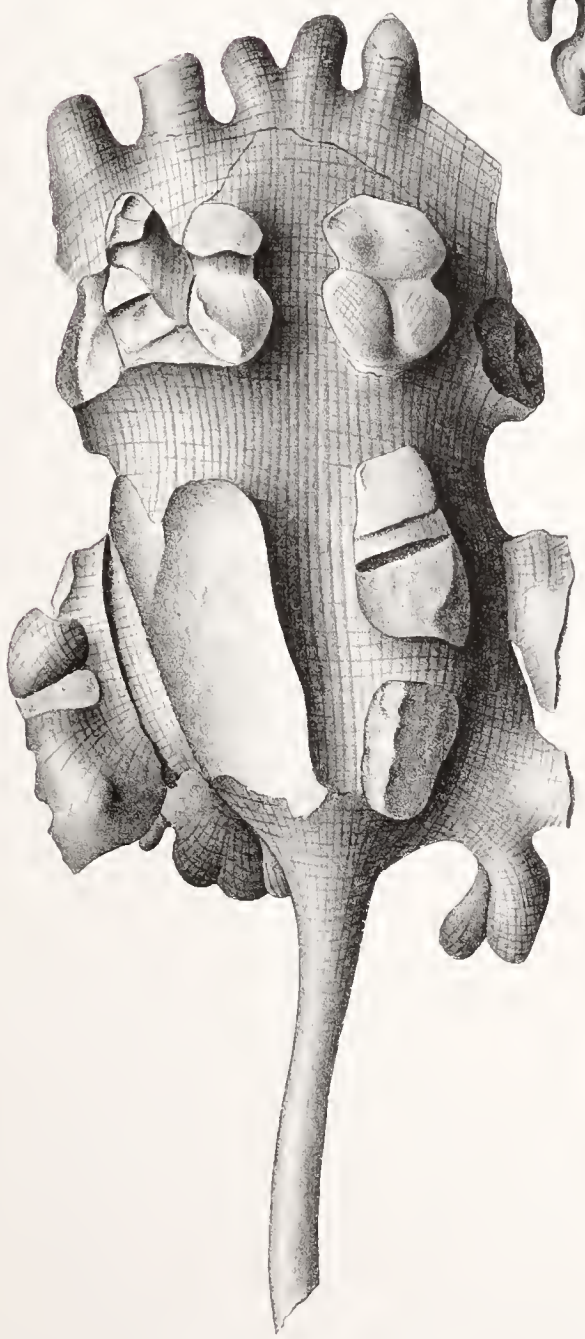

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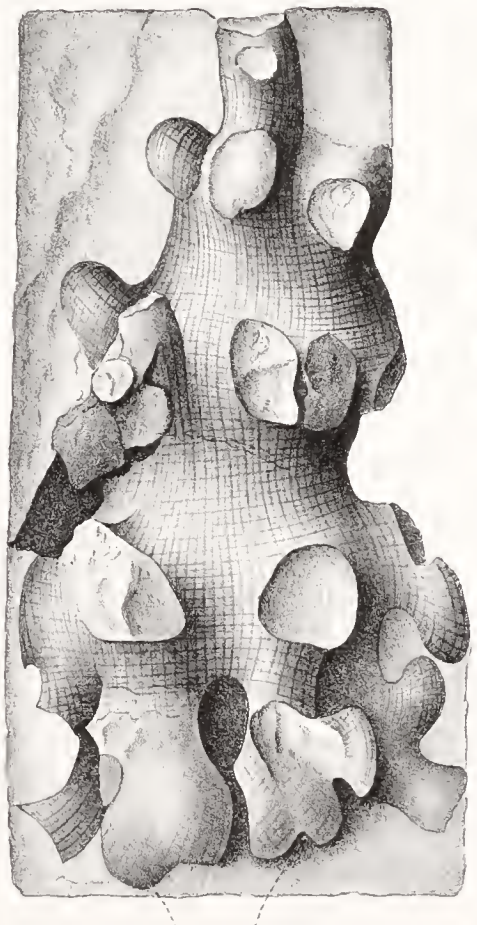

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PLATE XIV.

CLATHROSPONGIA, Hall.

Page 121.

(See Plates XV, XVIII, XXI, XXV, XLIX, L.)

CLATHROSPONGIA (?) HAMILTONENSIS, Hall (sp.).

Page 66.

Figure 1. The original specimen, which is a calcareous replacement of the skeleton; showing the strong primary bands and the imperfectly retained lesser bands; also exhibiting the minute reticulation over small patches near the middle of the surface.
In the calcareous shales of the Hamilton group. *Canandaigua lake, New York.*

CLATHROSPONGIA FENESTRATA, Hall (sp.).

Page 122.

(See Plate XXV.)

Figure 2. A view of the original specimen, from the drawing given in the Sixteenth Annual Report of the N. Y. State Cabinet of Natural History, 1863, pl. 3, fig. 4.
Chemung group. *Chemung narrows, New York.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

Page 73.

(See Plates XV, XVI, XXVII, XXXVI.)

Figure 3. A slender, well preserved and nearly entire individual, showing the prevailing form of the species and the elongate rectangular shape of the primary meshes of the net-work.

Figure 4. A specimen of similar character, but accidentally curved.
Chemung group. *Friendship, New York.*

Figure 5. A somewhat smaller example preserving the finer divisions of the reticulum.

Figure 6. Two very small examples regarded as the young of this species.
Chemung group. *Wellsville, New York.*

DICTYOSPONGIDÆ.

3

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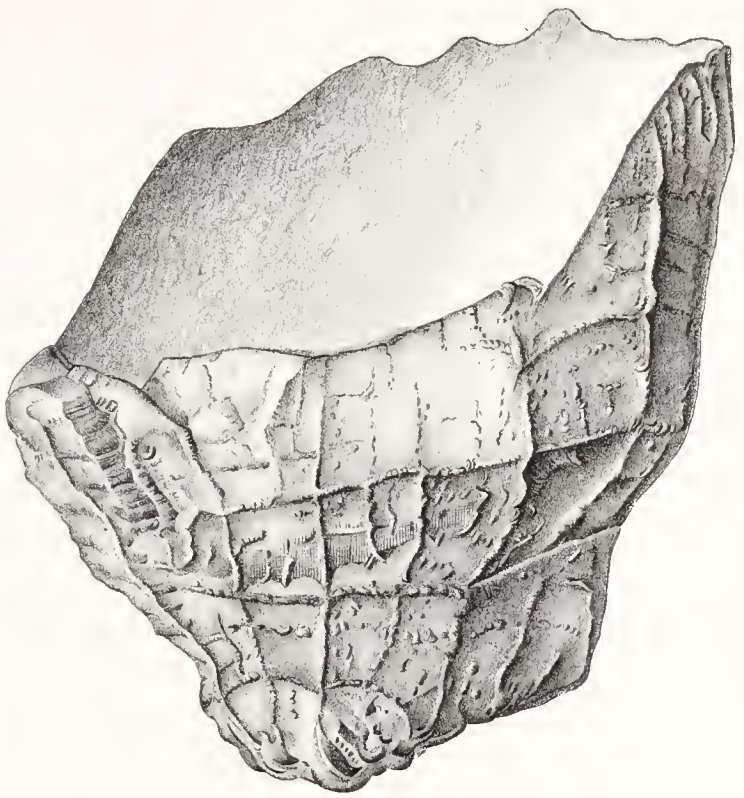

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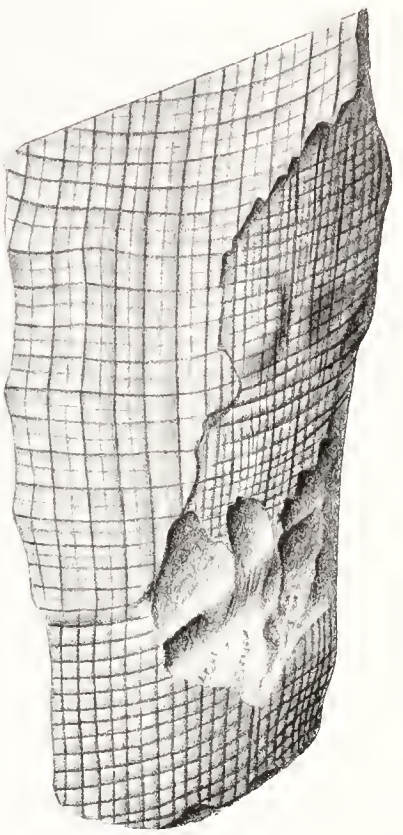

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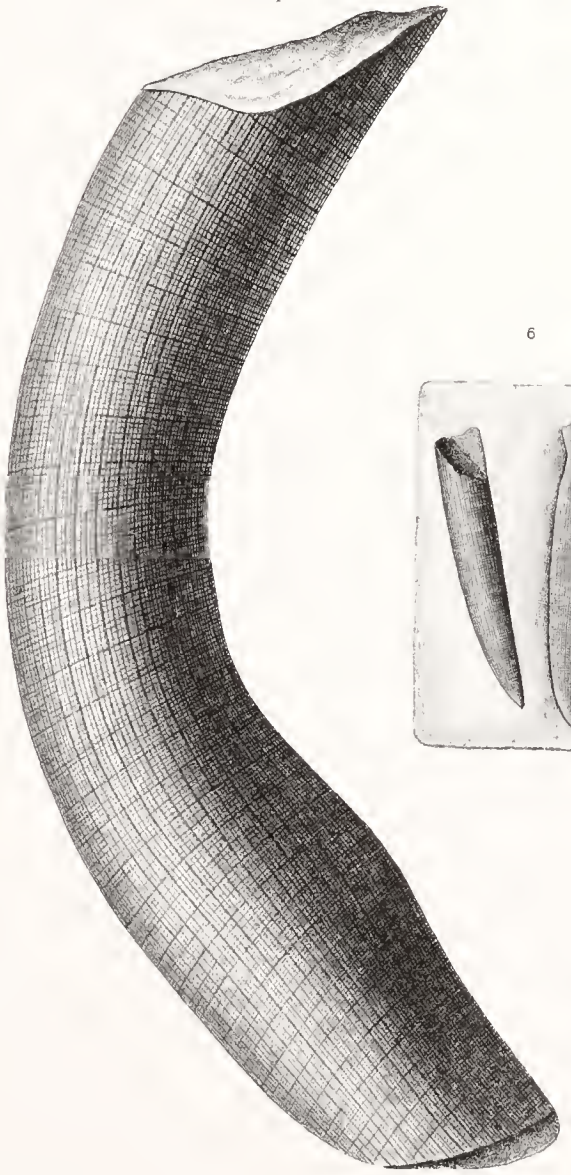

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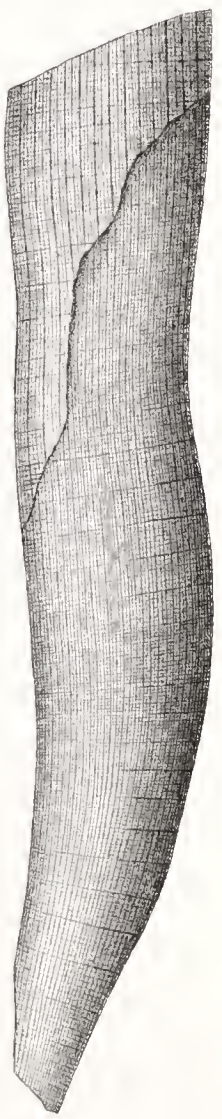

PLATE XV.

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA EUMORPHA, sp. nov.

Page 75.

Figure 1. A small, entire individual, showing the fine, square meshes of the net-work.

Figure 2. A larger, more elongate and slender example.

Figure 3. A broader cup with the fine reticulation retained over but a part of the surface.

Chemung group. *Wellsville, New York.*

DICTYOSPONGIA CHARITA, sp. nov.

Page 74.

Figure 4. An entire sponge with the basal tuft retained.

Chemung group. *Wellsville, New York.*

DICTYOSPONGIA LOPHURA, sp. nov.

Page 74.

Figure 5. The original specimen, an entire cup showing the elongate rectangular quadrules and the extended basal tuft.

Chemung group. *Wellsville, New York.*

CLATHROSPONGIA, Hall.

Page 121.

(See Plates XIV, XVIII, XXI, XXV, XLIX, L.)

CLATHROSPONGIA (?) IRREGULARIS, Hall (sp.).

Page 124.

Figures 6, 7. Opposite sides of the original specimen; showing the form of the sponge and the character of its reticulation.

Chemung (Portage ?) group. *Ithaca, New York.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

Page 73.

(See Plates XIV, XVI, XXVII, XXXVI.)

Figures 8, 9. Opposite sides of a large, somewhat flattened individual, showing the characteristic surface reticulation.

Chemung group. *Friendship, New York.*

DICTYOSPONGIDÆ.

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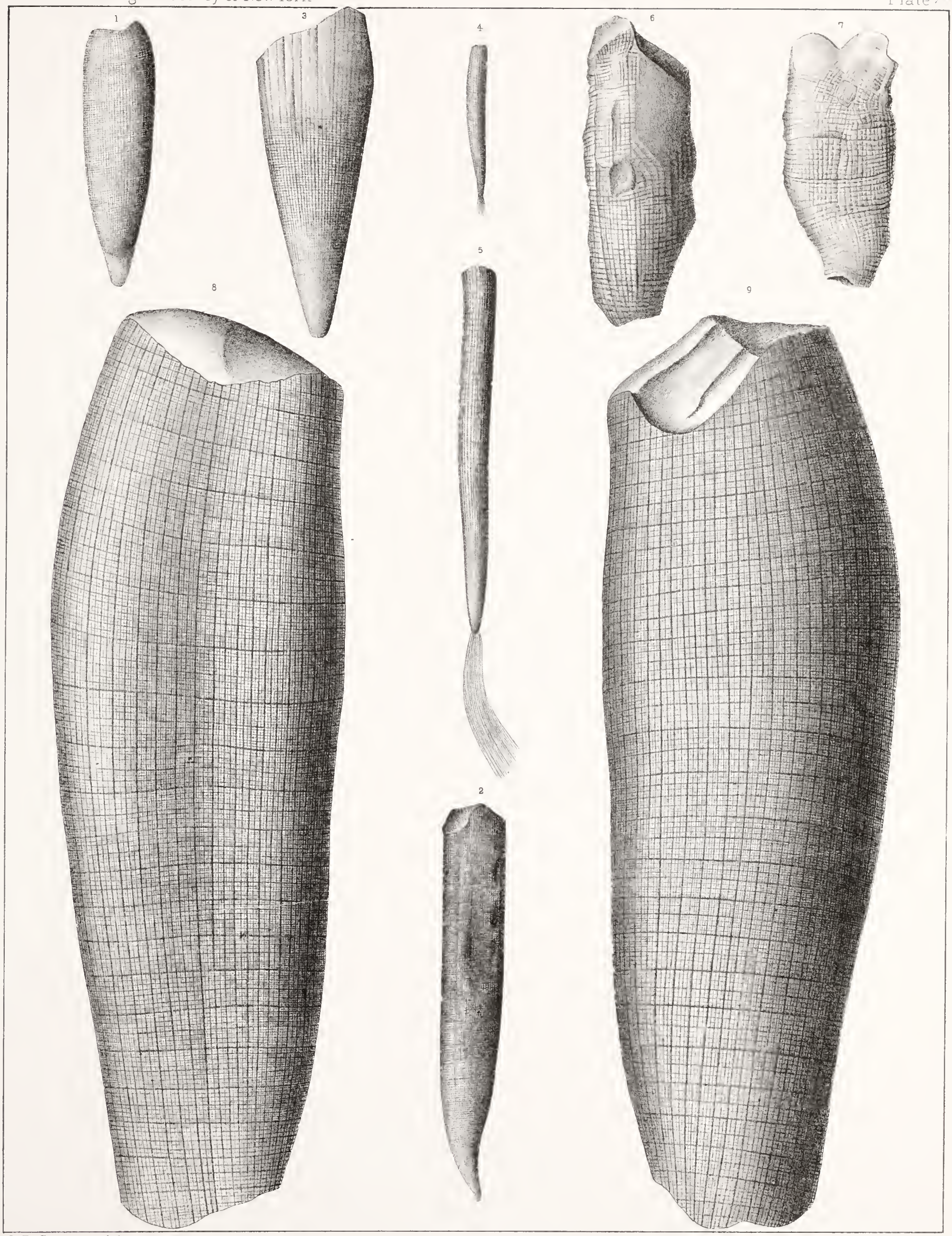
Plate X



G B Simpson del

Philp Ast lith

PLATE XVI.

RHABDOSISPONGIA, gen. nov.

Page 116.

(See Plate XLVII.)

RHABDOSISPONGIA AMALTHEA, Hall (sp.).

Page 116.

Figure 1. A nearly entire individual with broad annulations and sharp vertical ridges. Drawn from a plaster cast of the original specimen which was from the

Chemung group. *Great Bend, Susquehanna county, Pennsylvania.*

HYDRIODICTYA, gen. nov.

Page 77.

(See Plates IV, V, XXI.)

HYDRIODICTYA CYLIX, sp. nov.

Page 78.

(See Plate V.)

Figure 2. The external impression of a large individual somewhat crumpled by compression; showing the prevailing coarse and square meshes of the reticulum. Near the middle of the sponge a break in the net-work has been repaired by highly irregular spicular bands.

Chemung group. *Deyo basin, Naples, New York.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

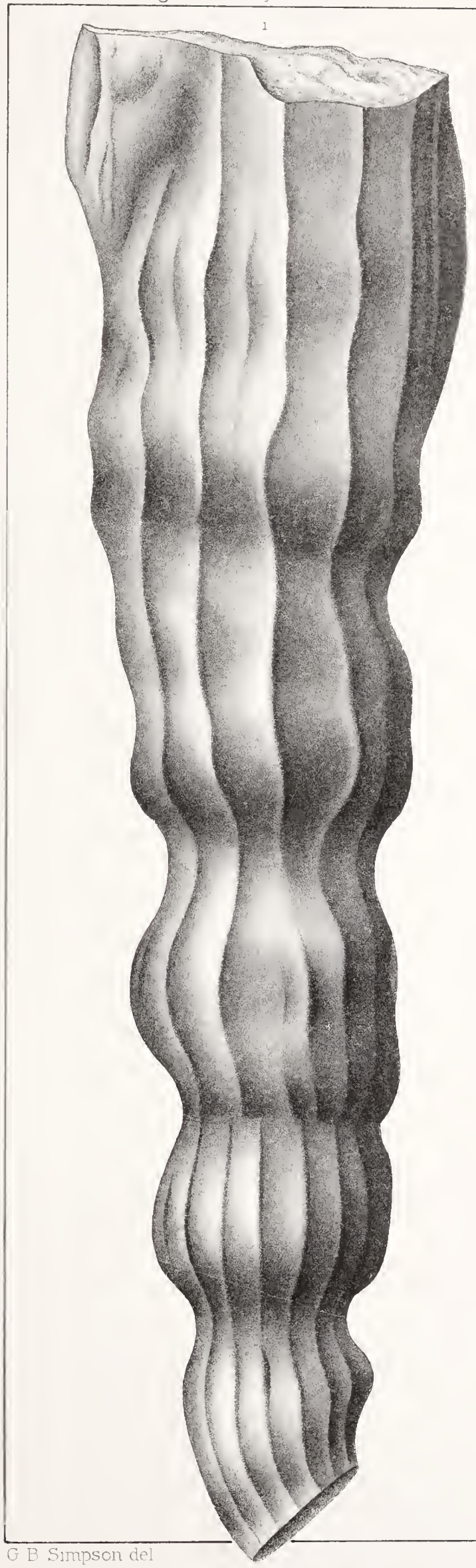
Page 73.

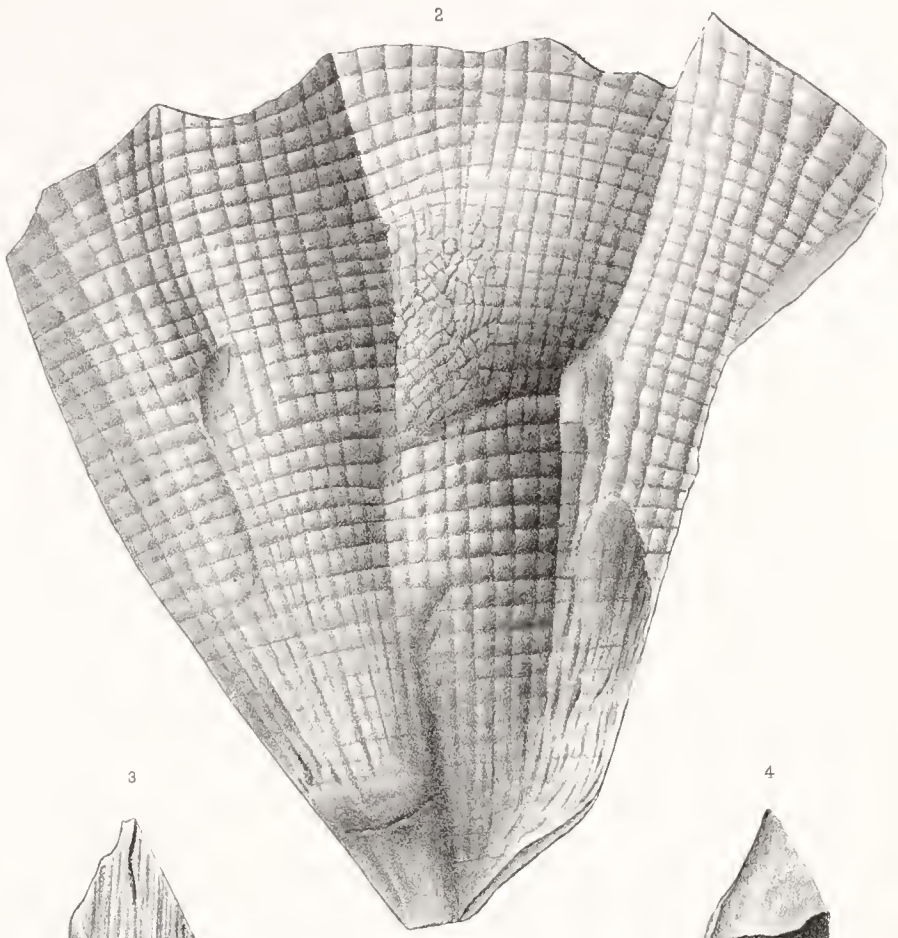
(See Plates XIV, XV, XXVII, XXXVI.)

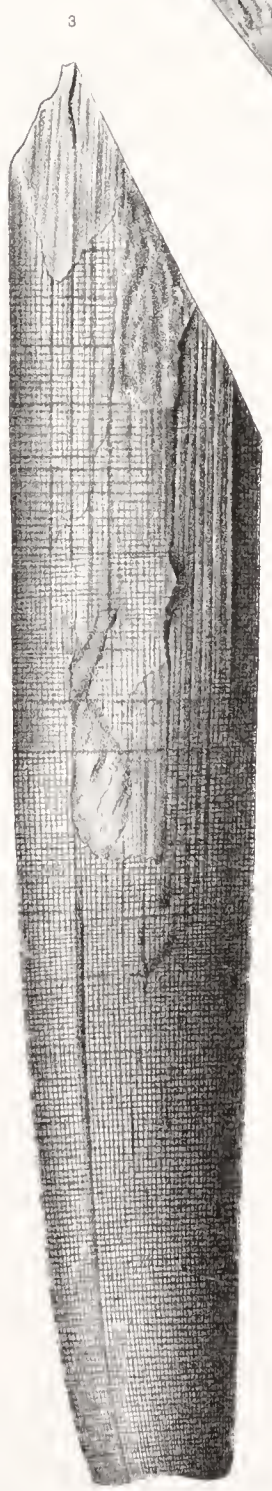
Figures 3, 4. Opposite sides of a slender but imperfect specimen; showing a difference in the preservation of the reticulum. In figure 4, the exposed side is a sharp internal cast and clearly shows the elongate rectangles produced by the intersection of the primary lamellae, while the surface represented in figure 3 is involved in a muddy or shaly sediment which has retained the finer net-work of the outer wall.

Chemung group. *Friendship, New York.*

DICTYOSPONGIDÆ.







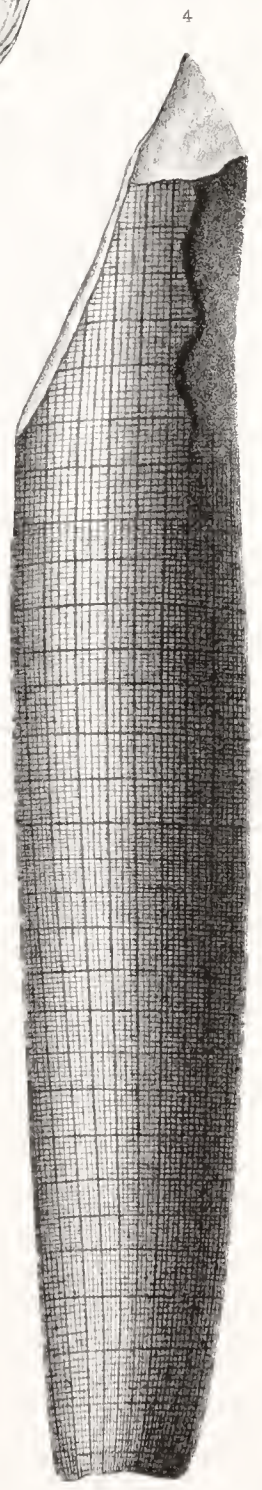


PLATE XVII.

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA PRISMATICA, Hall (sp.).

Page 83.

(See Plates XXI and XLII.)

Figure 1. An incomplete specimen showing a tendency to spiral growth.

Chemung group. *Wellsville, New York.*

PRISMODICTYA BANANO, sp. nov.

Page 87.

Figure 2. The type-specimen, which is an essentially entire individual of very slender and gracefully tapering form.

Chemung group. *Scio, Allegany county, New York.*

PRISMODICTYA TELUM, Hall (sp.).

Page 80.

(See Plates XXXV and XLII.)

Figure 3. Two individuals, one of them entire and with the normal proportions of the species, the other somewhat imperfect and having a curvature which appears to be the result of natural growth. Both bear casts of spiral vermiform tubes or furrows.

Figures 4, 5. Opposite sides of an entire individual. The surface represented in figure 4, is somewhat worn but shows distant obscure horizontal grooves; that shown in figure 5, is slightly broken at the aperture and has the horizontal grooves represented by sharper reticular furrows.

Chemung group. *Wellsville, New York.*

Figure 6. An entire individual of small size and undisturbed proportions, showing the character of the reticulation and the form and size of the aperture. Here as in figures 5 and 7, the prism-faces are made to appear somewhat too concave.

Figure 8. Basal view of the same specimen.

Chemung group. *Cattaraugus county, New York.*

Figure 7. A small entire example.

DICTYOSPONGIDÆ.

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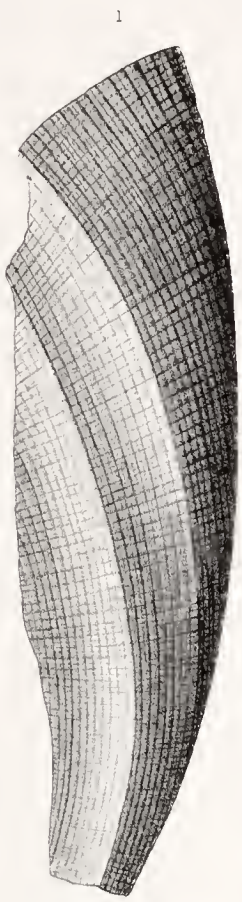
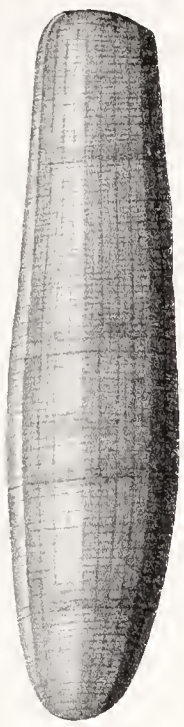
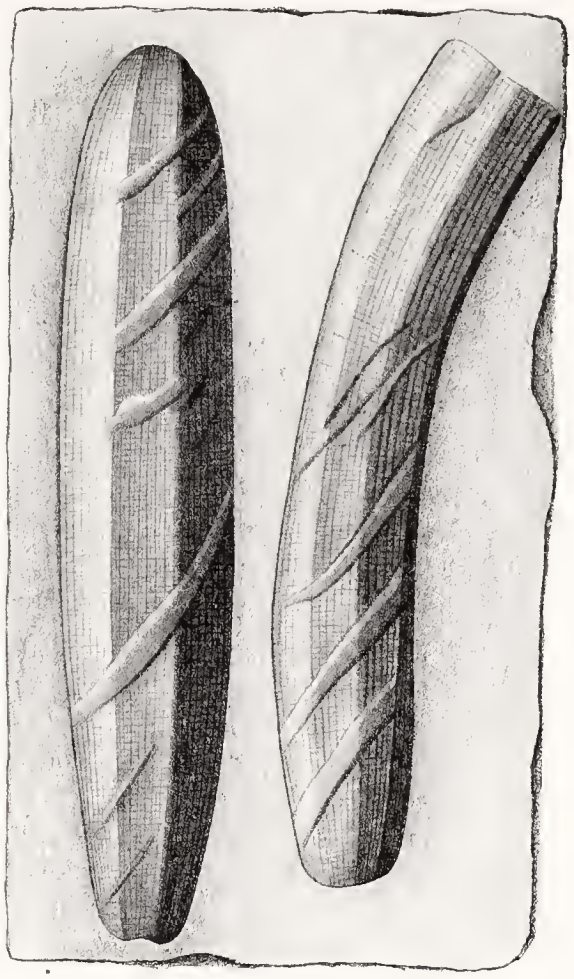
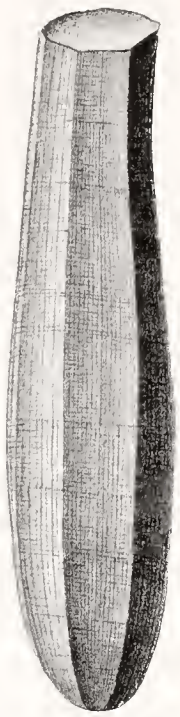
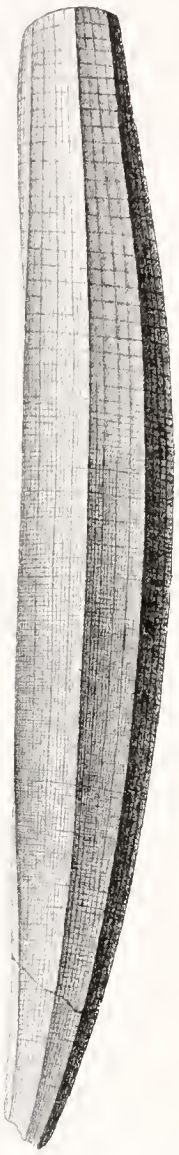
Plate XVII

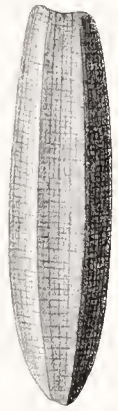


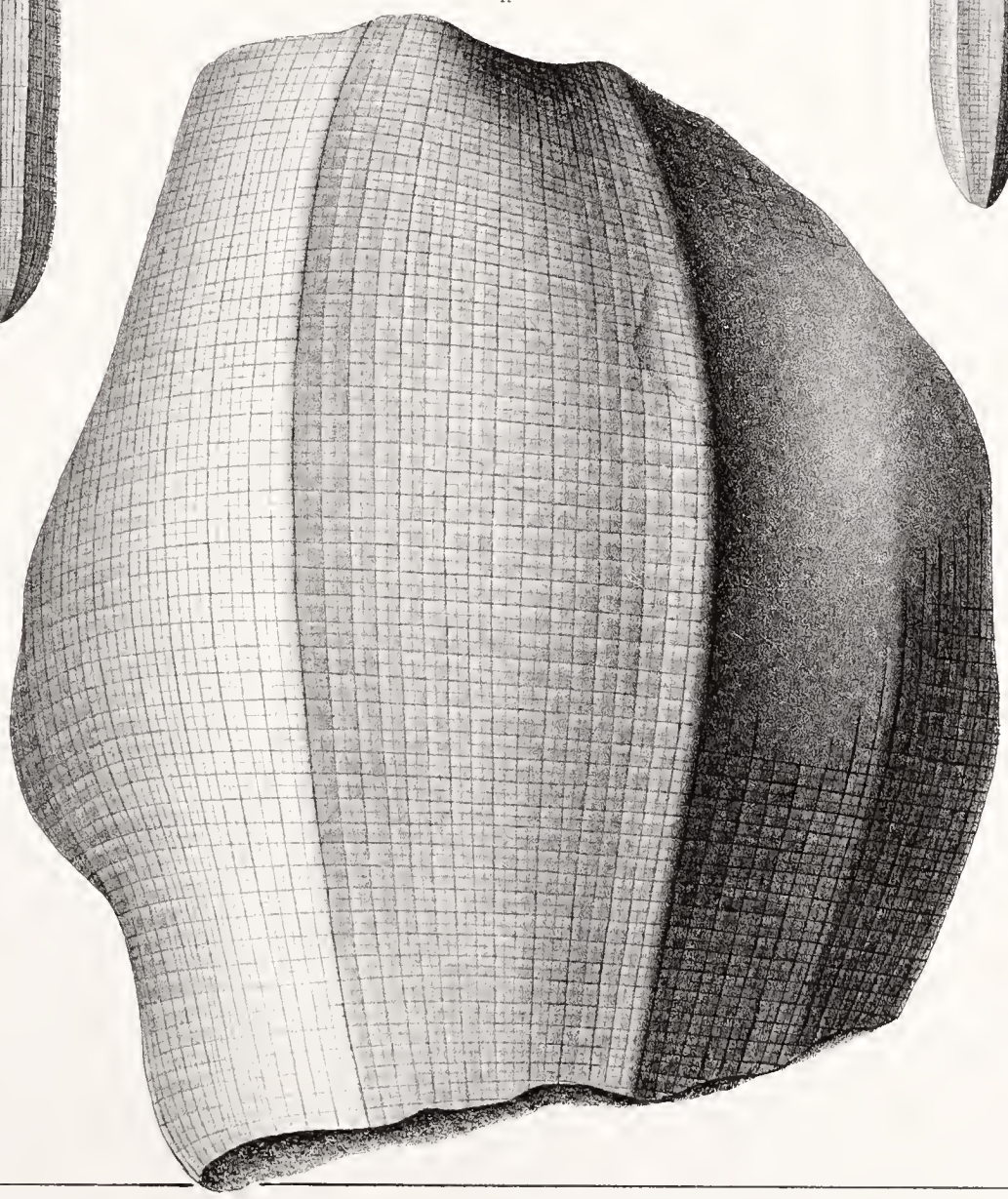


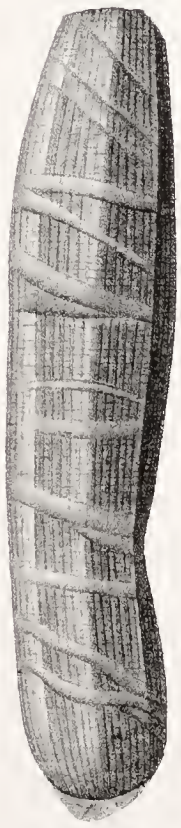












G.B Simpson del

Philip Ast lith

Figures 9, 10. Opposite sides of an entire specimen showing the marks of encircling or spiral tubes, probably made by a commensal annelid. On one side of the specimen (fig. 9) these are preserved as ridge-like casts and on the other (fig. 10) as furrows.

The specimens represented in figures 3, 4, 5, 7, 9 and 10 are from a single slab crowded with individuals of this species.

Chemung group. *Wellsville, New York.*

PRISMODICTYA CORYNIA, sp. nov.

Page 86.

Figure 11. The upper portion of a very large sponge with broadly expanded prism-faces and a coarse square reticulation.

Chemung group. *Wellsville, New York.*

PLATE XVIII.

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA BACULUM, Hall (sp.).

Page 81.

Figures 1, 2. Opposite sides of an incomplete sponge which is referred to this species.

Chemung group. *Alfred, New York.*

Figure 3. The type-specimen, an incomplete cup, slender near the base and expanded toward the aperture. The specimen is a sharp internal cast, showing the regularity of the primary reticulation.

Chemung group. *Wellsville, New York.*

PRISMODICTYA CONRADI, Hall (sp.).

Page 91.

(See Plate XIX.)

Figure 4. Lateral view of the original specimen; showing the regularly expanding form, the character of the reticulation and, over the upper part of the sponge, the somewhat irregular tendency to the formation of nodes upon the prism-faces.

Chemung group. *Randolph, Cattaraugus county, New York.*

CLATHROSPONGIA, Hall.

Page 121.

(See Plates XIV, XV, XXI, XXV, XLIX, L.)

CLATHROSPONGIA (?) TOMACULUM, Hall (sp.).

Page 123.

(See Plate XXI.)

Figures 5, 6. Opposite sides of the type-specimen, which is a portion of a large, very gradually expanding sponge with low and narrow prism-faces. The reticulation is coarse and over most of the exposed surfaces shows a prevalence of square meshes. The curvature of the specimen is probably accidental.

Chemung group. *Alfred, New York.*

DICTYOSPONGIDÆ.

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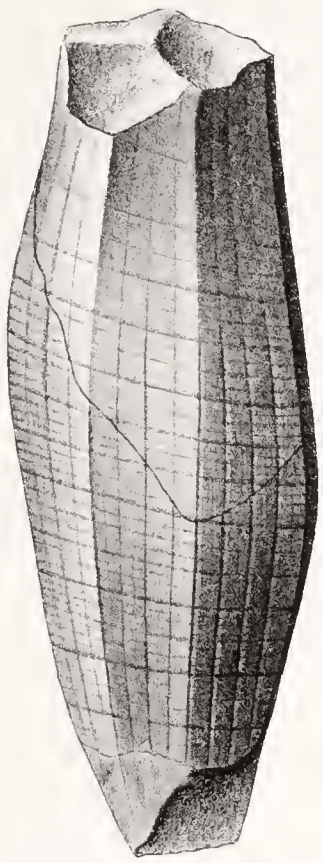

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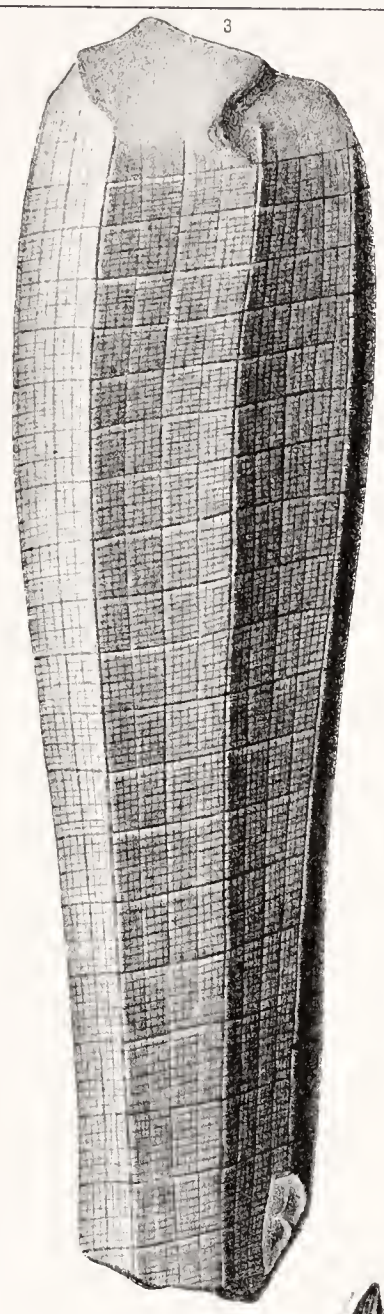

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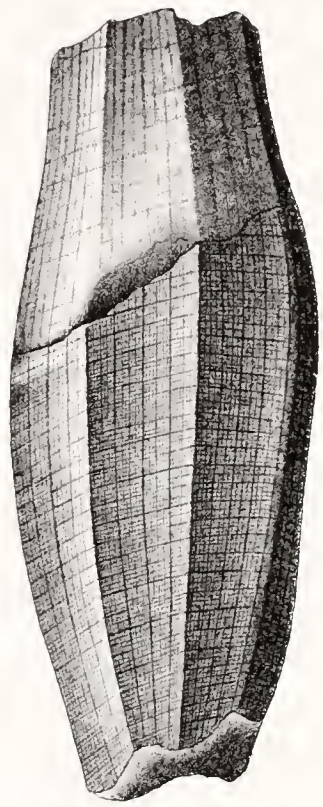

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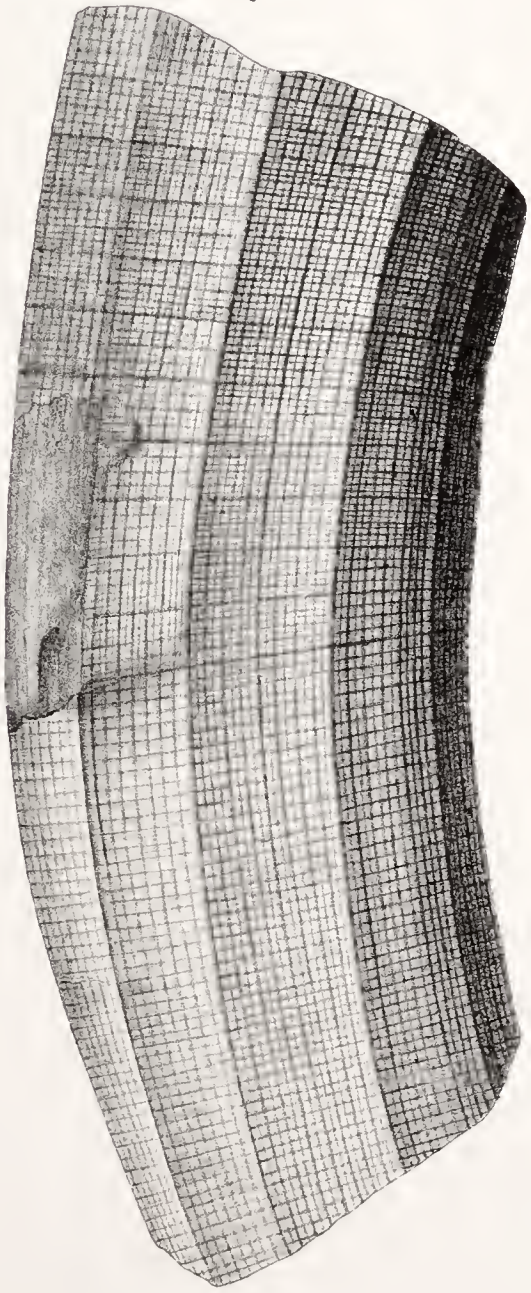

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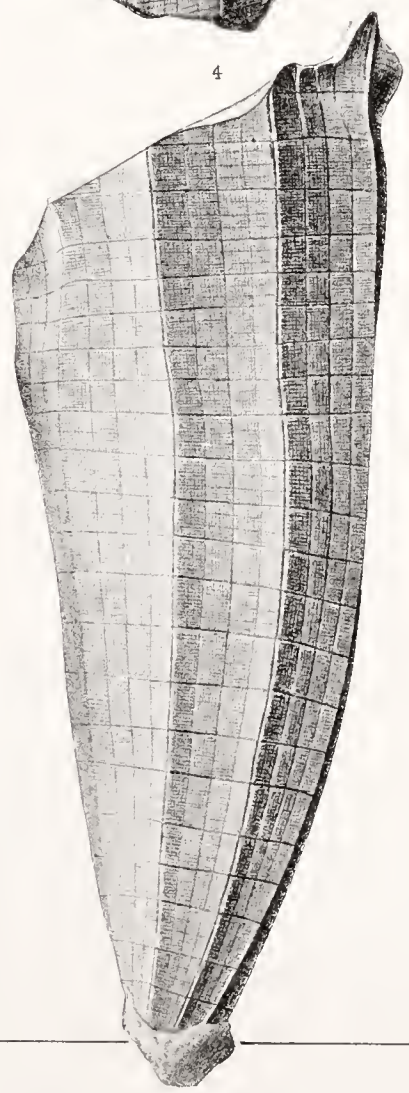

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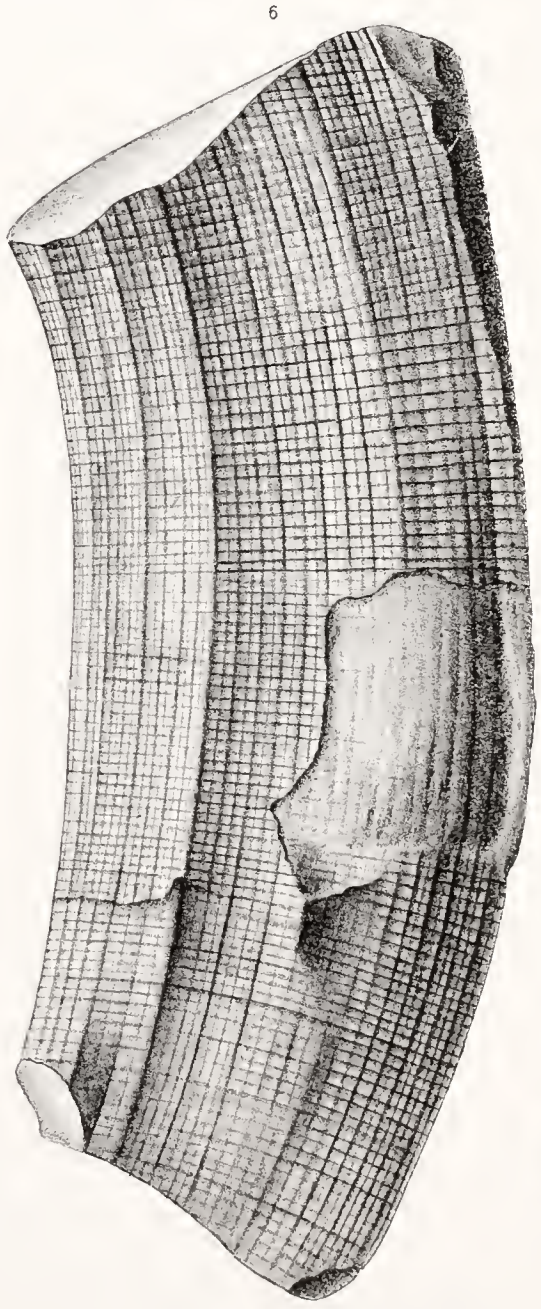

PLATE XIX.

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA CHOANEA, sp. nov.

Page 85.

(See Plates XXVII and XXXV.)

Figure 1. The basal portion of a specimen of medium size, showing a fine reticulum and faint traces of prism-faces.

Figure 2. A similar portion of a larger specimen.

Chemung group. *Ischua, Cattaraugus county, New York.*

Figure 3. The upper portion of a large cup, believed to represent this species; having the prism-faces obsolescent and an extremely fine reticulum This specimen is accompanied by fragments of others of the same species and impressions of the brachiopod, *Spirifer disjunctus.*

Chemung group. *Almond, Allegany county, New York.*

PRISMODICTYA PARALLELA, Hall (sp.).

Page 82.

(See Plates XX, XXI, XXXV.)

Figure 4. The exterior of a portion of a cup, showing its gradual expansion, the somewhat obscure and rounded prism-faces and the sharply elevated primary reticular bands. This is drawn from a plaster-cast of the original specimen, which is an external impression in sandstone.

Chemung group. *Southwestern New York (precise locality unknown).*

PRISMODICTYA CONRADI, Hall (sp.).

Page 91.

(See Plate XVIII.)

Figure 5. An apical view of the basal extremity of the specimen shown on plate 18, figure 4.

Figure 6. Side view of the same specimen presenting its narrower diameter and showing the irregular node at the top.

Chemung group. *Randolph, Cattaraugus county, New York.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate XIX.

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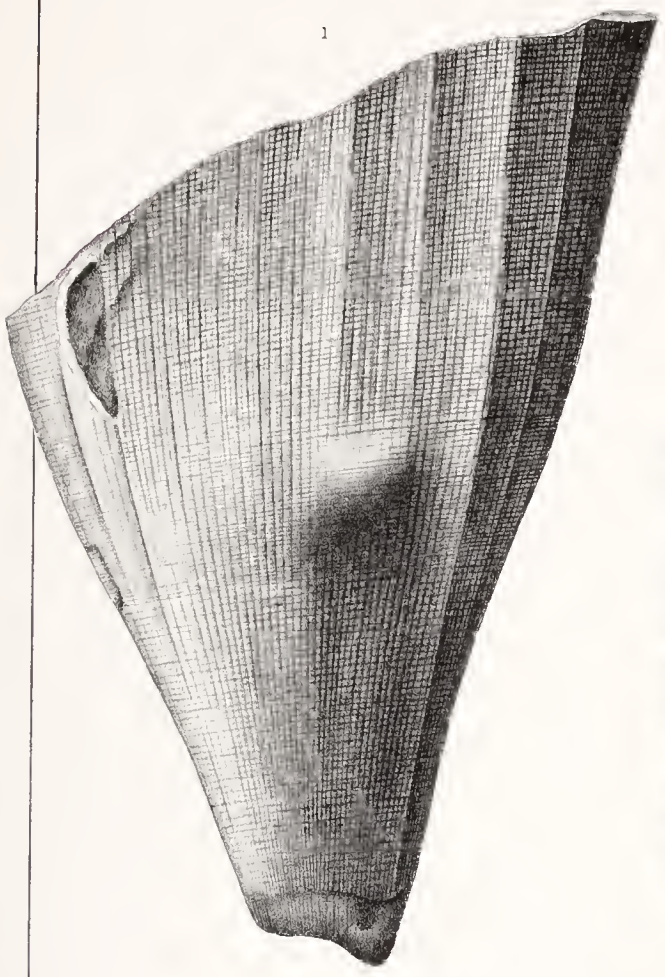

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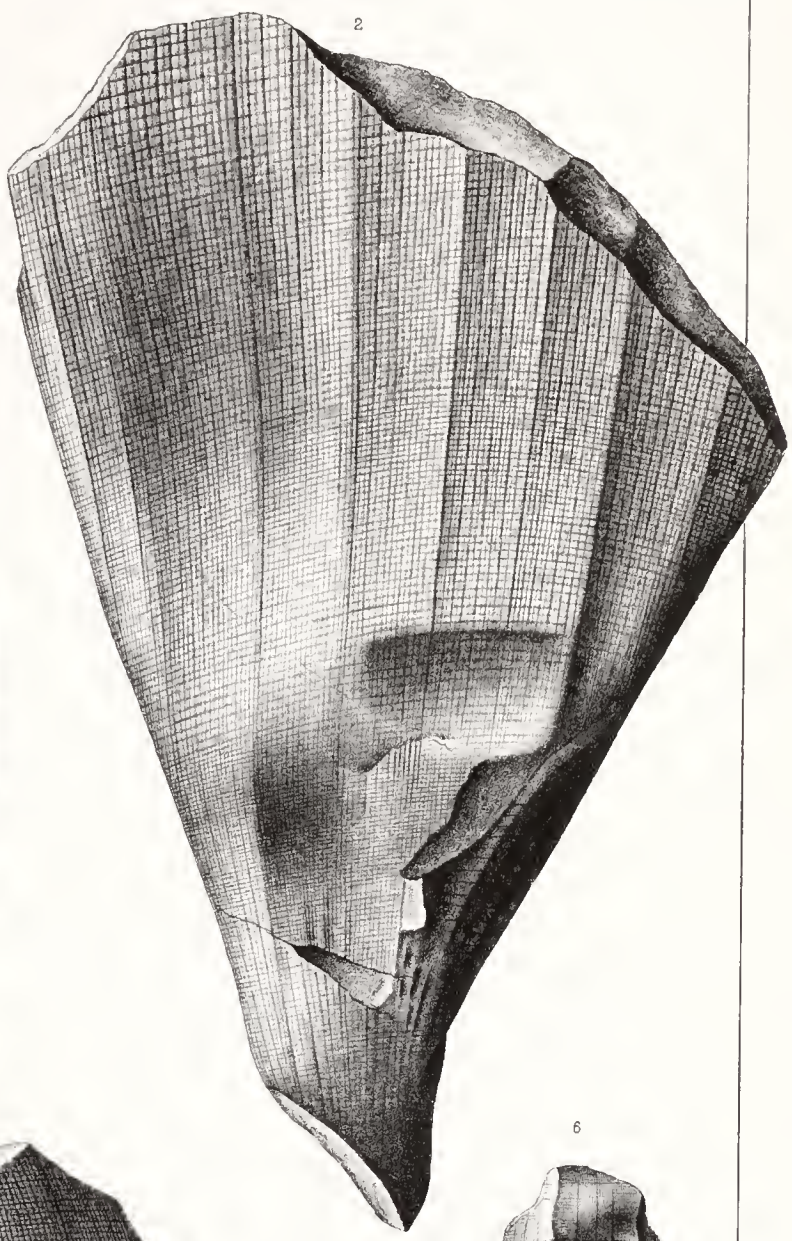

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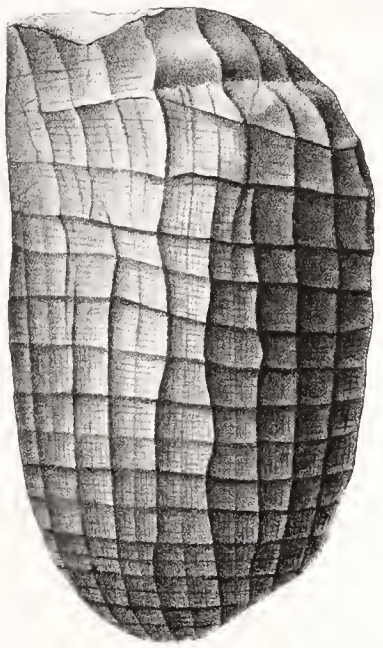

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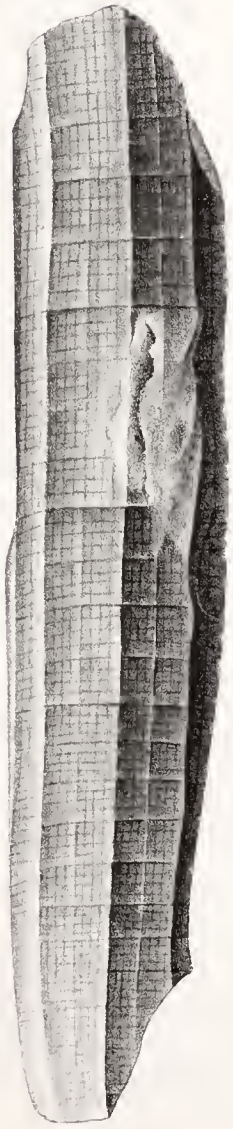

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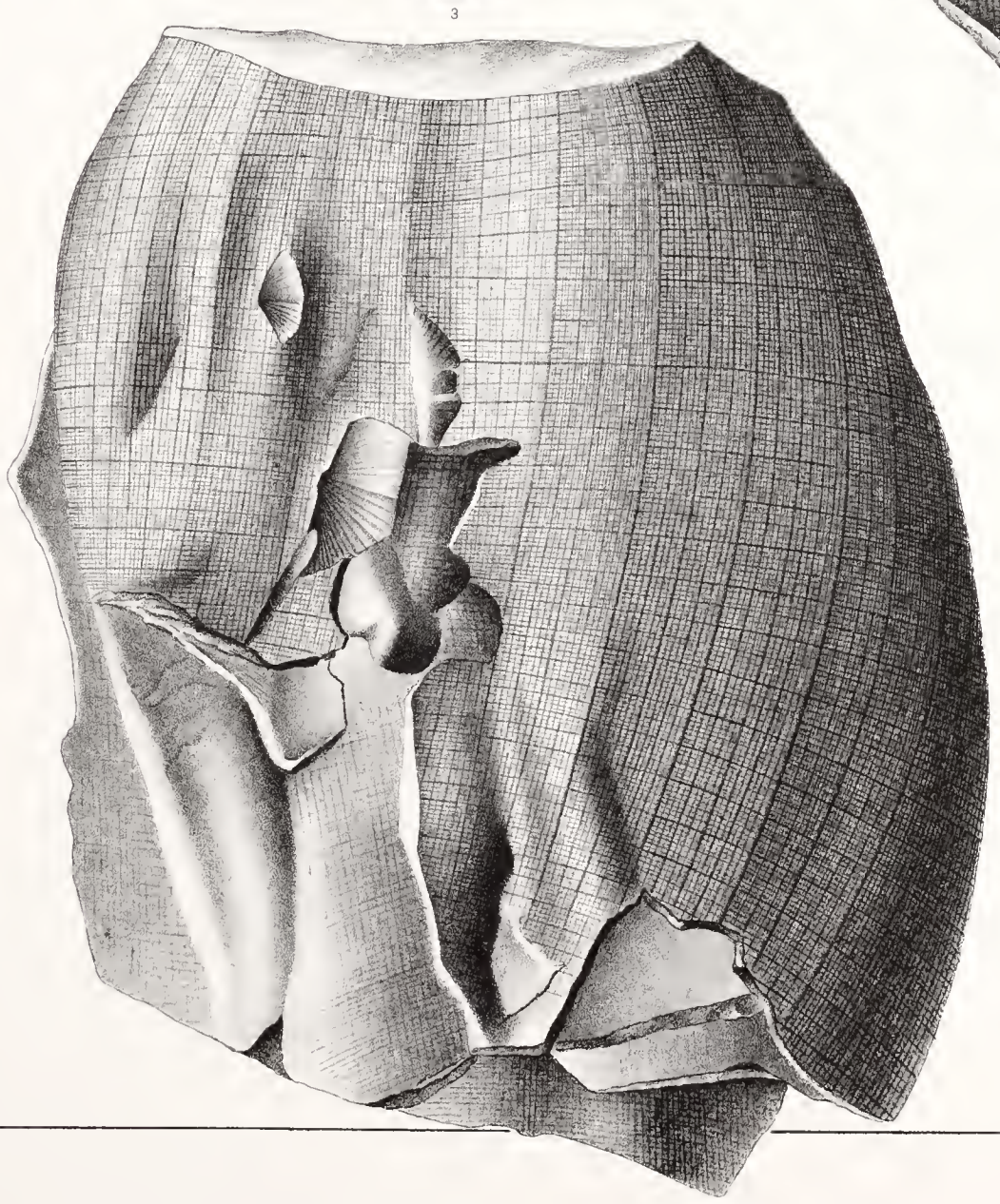

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G.B Simpson del

Phlip Ast lith

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XXIII, XXIV, XXV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA RUDIS, Hall (sp.).

Page 128.

(See Plate XXIII.)

Figure 7. A fragment of a cup showing the coarse, square primary spicular bands and the very fine subordinate reticulation.
Chemung group. *Wellsville, New York.*

PLATE XX.

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA CERCIDEA, sp. nov.

Page 89.

(See Plate XLII.)

Figure 1. An entire flattened, though symmetrical specimen, with subequal extremities. It is possible that the spot at the lower end may represent the aperture and the specimen have thus been drawn in an inverted position, but this is uncertain as the margins of this spot are not so clearly defined as here represented and the other extremity is not fully uncovered.

Figures 2, 3. Opposite sides of another example which has been obliquely compressed.

Chemung group. *Wellsville, New York.*

PRISMODICTYA ALLEGANIA, sp. nov.

Page 84.

Figure 4. A fragment of a very large individual showing the upward expansion of the sponge, the median division of the prism-faces and the fine reticulation.

Chemung group. *Scio, New York.*

PRISMODICTYA SPECTABILIS, sp. nov.

Page 82.

Figure 5. A nearly entire specimen representing a fine sponge, which attains its greatest expansion shortly above the base and is regularly prismatic for the rest of its extent. The prism-faces are not developed near the base of the cup, although thus represented in the lithograph, but the surface about the apex is smooth and round for a considerable distance.

Chemung group. *Wellsville, New York.*

PRISMODICTYA PARALLELA, Hall (sp.).

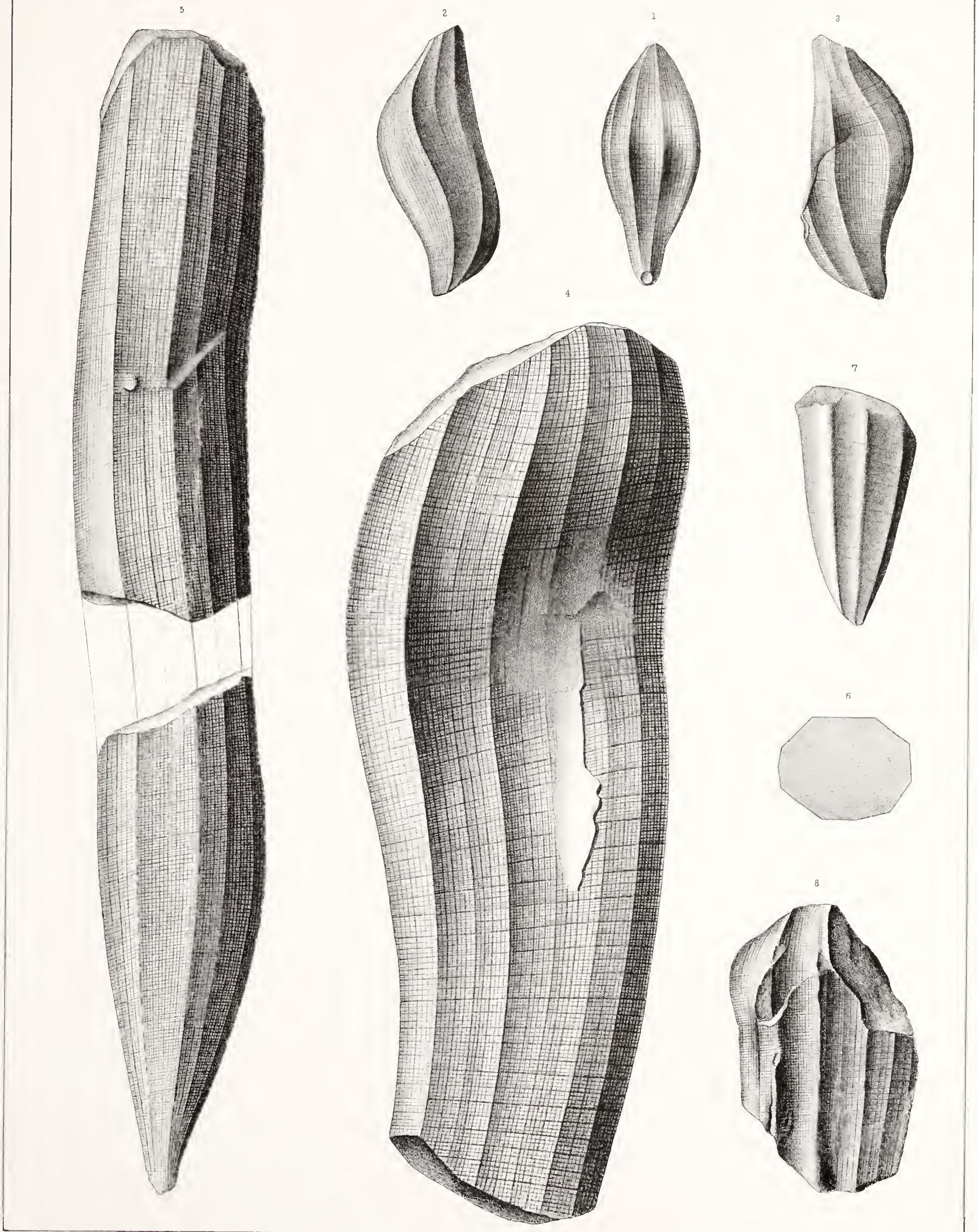
Page 82.

Figure 6. Transverse section of an uncompressed specimen.

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate XX



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Philip Ast lith

PRISMODICTYA AULOPHIA, sp. nov.

Page 88.

(See Plates XXXIV and XLI.)

Figure 7. The basal portion of a weathered specimen; showing the concave prism-faces.

Figure 8. A fragment of the median portion of a specimen; showing the concave prism-faces and the extremely fine surface reticulation.

Chemung group. *Wellsville, New York.*

PLATE XXI.

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XX, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA PRISMATICA, Hall (sp.).

Page 83.

(See Plates XVII and LXII.)

Figure 1. The apertural end of an average specimen; showing the slight contraction toward the margin.

Figure 2. A portion of a small and very slender example.

Figure 3. A portion of an individual having a tendency to spiral growth.

Figure 4. A nearly entire individual of average size.

Figure 5. An enlargement of the surface of an internal cast; showing the character of the reticulation and the rows of depressions on the prism-angles at their intersection with the principal horizontal spicular bands. Such pits probably represent the bases of spicular tufts.

Figure 6. Another internal cast also showing vertical rows of pits.
Chemung group. *Concord station, Erie county, Pennsylvania.*

PRISMODICTYA FILITEXTILIS, Hall (sp.).

Page 86.

(See Plate XXVII.)

Figure 7. A gutta-percha squeeze of the original specimen which is an external cast showing a fine reticulum and very obscure prism-faces.
Chemung group *Steuben county, New York.*

PRISMODICTYA PARALLELA, Hall (sp.).

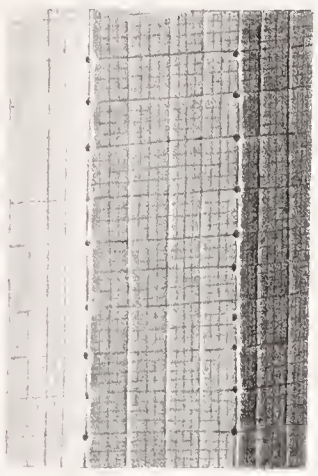
Page 82.

(See Plates XIX and XXXV.)

Figure 8. A fragment of a rather large, uncompressed specimen.

Figure 9. Transverse section of the same example.
Chemung group. *Wellsville, New York.*

DICTYOSPONGIDÆ.



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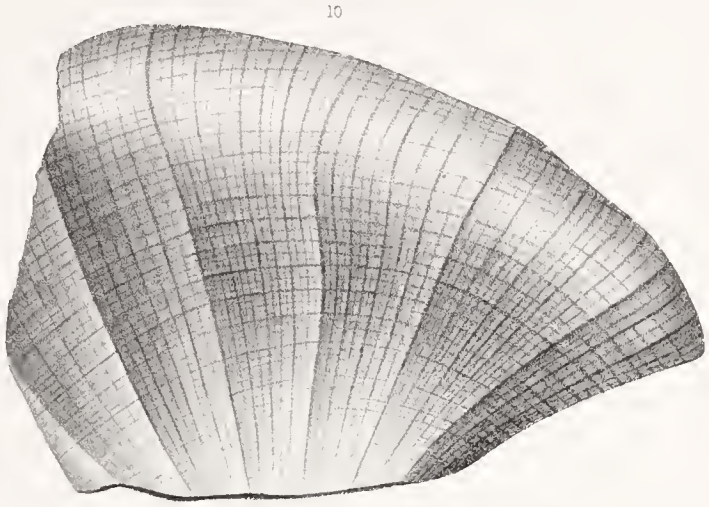

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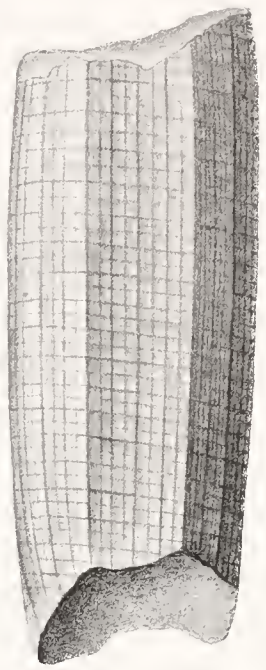

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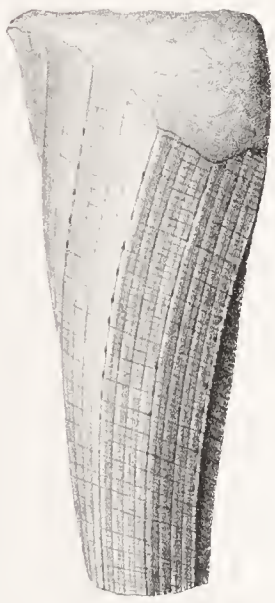

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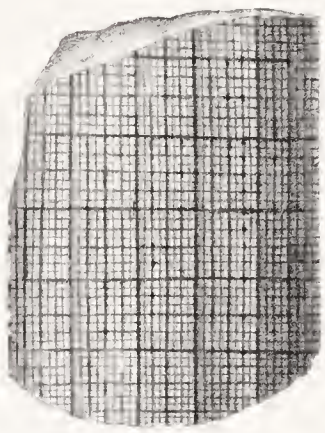

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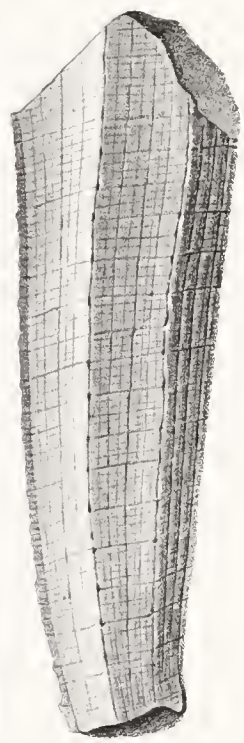

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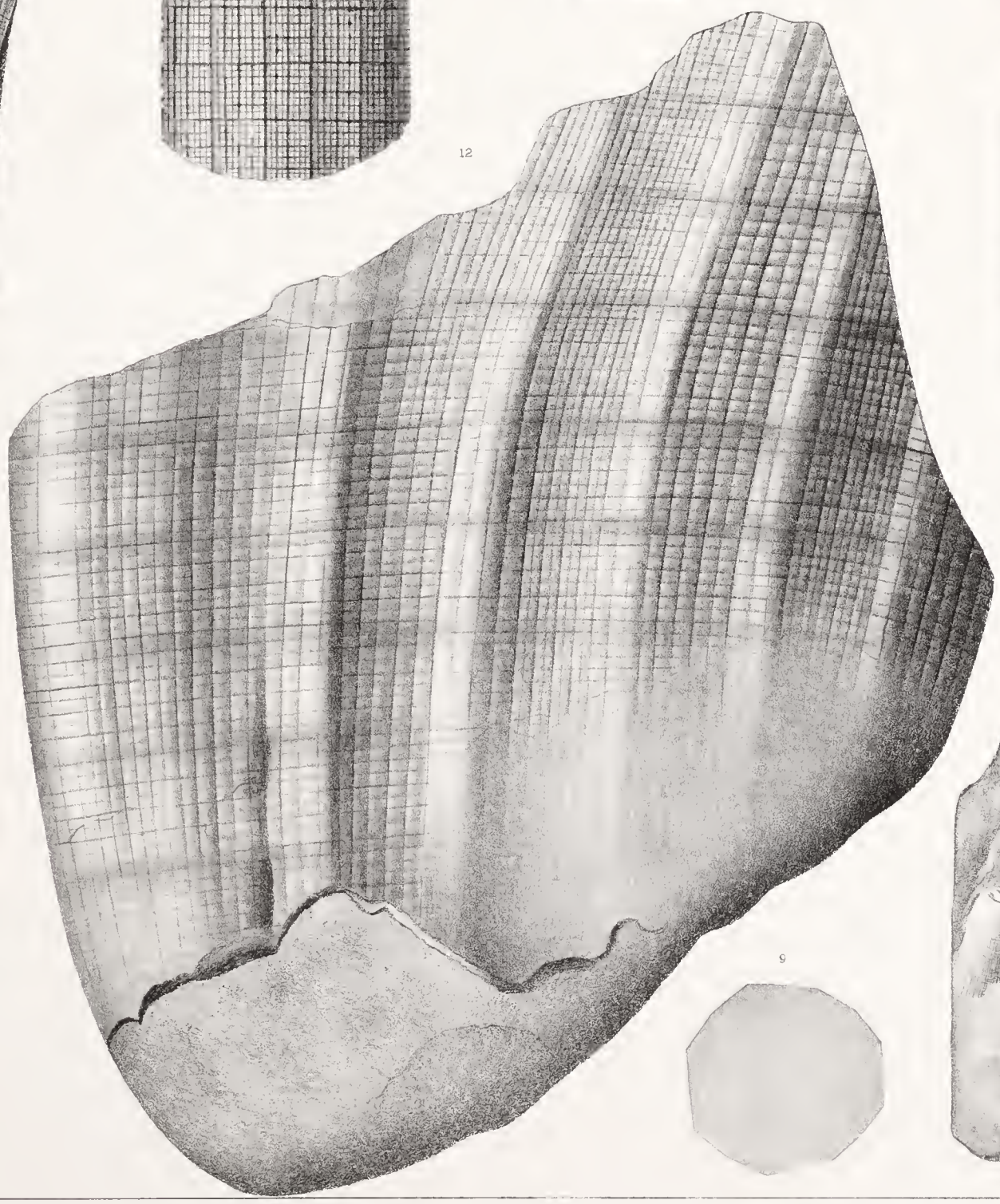

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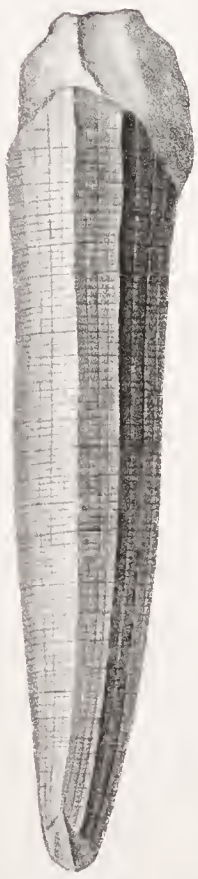

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Philip Ast lith

HYDRIODICTYA, gen. nov.

Page 77.

(See Plates IV, V, XVI, LV.)

HYDRIODICTYA NEPHELIA, sp. nov.

Page 79.

Figure 10. An incomplete specimen showing what appears to be the expanded apertural part of a vase-shaped cup with subprismatic faces.

Cemung group. *Scio, New York.*

CLATHROSPONGIA, gen. nov.

Page 121.

(See Plates XIV, XV, XVIII, XXI, XXV, XLIX, L.)

CLATHROSPONGIA (?) TOMACULUM, Hall (sp.).

Page 123.

(See Plate XVIII.)

Figure 11. A sharply defined cast of a portion of the exterior showing the character of the quadrulation.

Chemung group. *Alfred, N Y.*

CLATHROSPONGIA VASCELLUM, Hall (sp.).

Page 123.

(See Plate XXV.)

Figure 12. The opposite side of the specimen shown on the plate cited. This surface exhibits traces of very coarse primary vertical spicular ridges and in places shows some of the finer reticulation.

Chemung group. *Alfred, N. Y.*

PLATE XXII.

HELICODICTYA, gen. nov.

Page 114.

(See Plate XXVII.)

HELICODICTYA TRYPANIA, sp. nov.

Page 114.

Figure 1. Lateral view of a compressed specimen, showing the spiral ridges parallel to one of the rectangularly reticulating spicular series.

Figure 2. The same specimen with the lower portion removed to show the continuity of the spiral ridges on the impression of the opposite side.

Chemung group. *Wellsville, New York.*

CERATODICTYA, gen. nov.

Page 117.

(See Plates XLI, XLII, XLIII.)

CERATODICTYA ANNULATA, Hall (sp.).

Page 120.

Figures 3, 4. Opposite sides of a large specimen with broad and low annulations.

Chemung group. *Deyo basin, Naples, New York.*

Figure 5. The original figure of the species, showing five short and subequal annulations.

Figure 6. Another view of the same specimen.

Chemung group. *Western New York (precise locality lost).*

CERATODICTYA CINCTA, Hall (sp.).

Page 118.

Figure 7. One side of the original specimen, showing below the disordered and interrupted growth of the annulations.

Figure 8. The opposite side of the same fragment, the growth of the annulations here being regular and undisturbed.

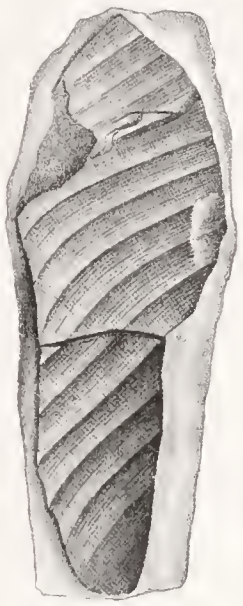
Figure 9. An end view of the specimen, showing the compression to which it has been subjected.

Chemung group. *From a boulder at Erie, Pennsylvania.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate XXII



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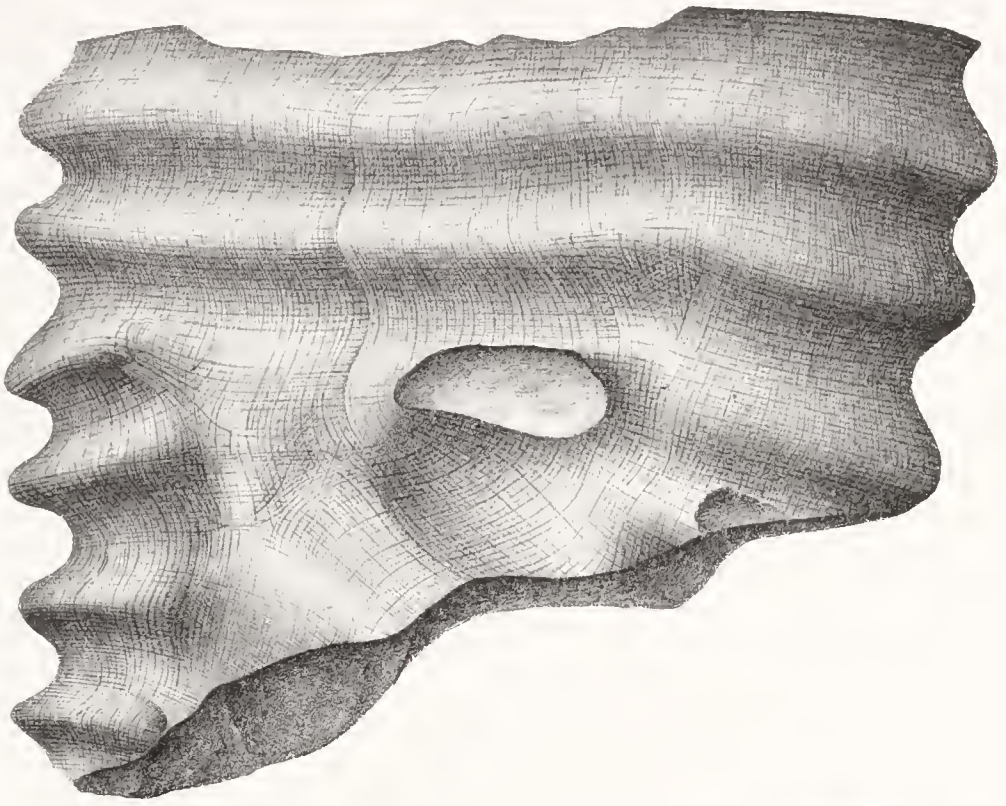

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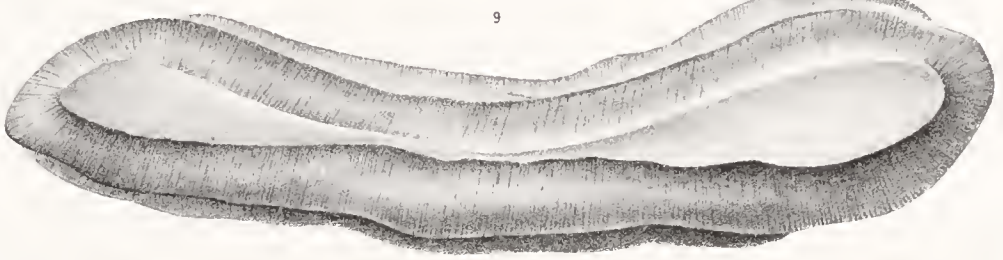

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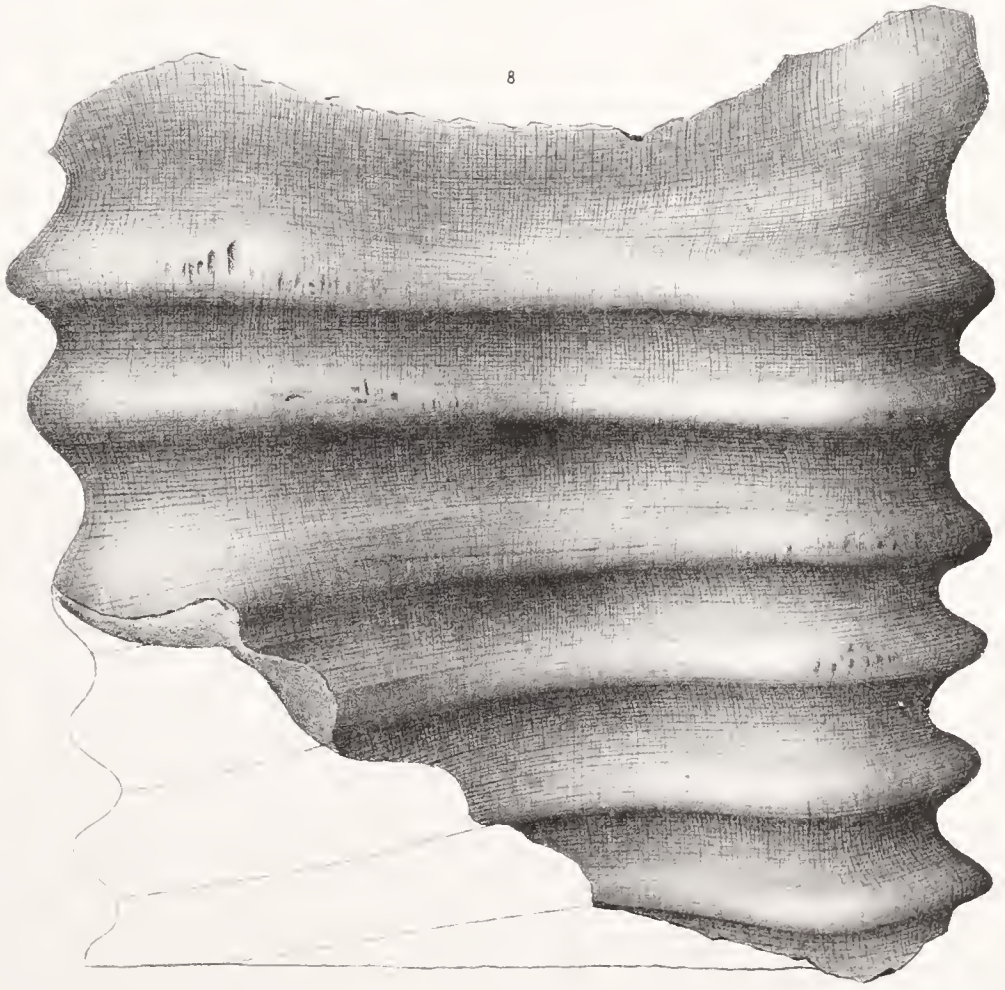

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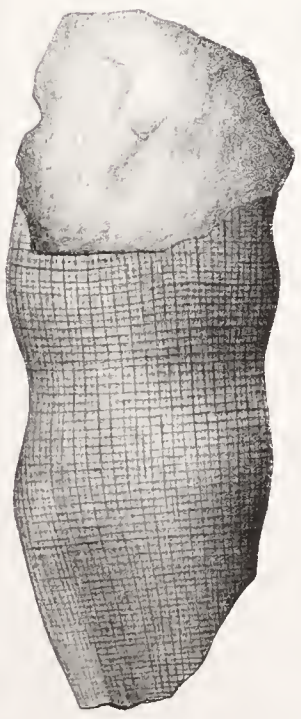

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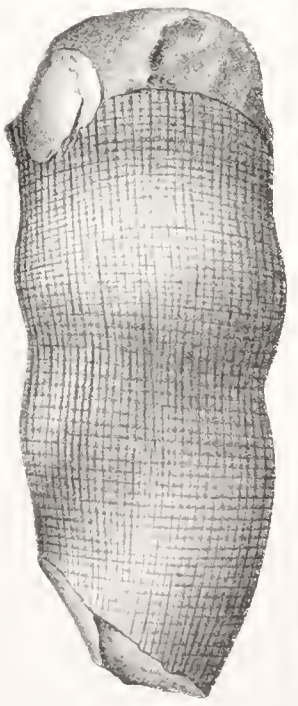

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PLATE XXIII.

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIV, XXV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA RUDIS, Hall (sp.).

Page 128.

(See Plate XIX.)

Figure 1. An essentially entire individual, showing the form of the aperture, the cylindrical body and coarse and fine reticulation.
Chemung group. *Ischua, Cattaraugus county, New York.*

Figure 2. A basal disk, probably of this species, showing the excentric apex, the concentric and apparently radial striae.
Chemung group. *Alma, Allegany county, New York.*

Figure 3. A portion of a specimen believed to be of this species; showing differences in the preservation of the reticulum on various parts of the surface.

Figure 4. The opposite side of the same specimen lying in its matrix and showing the projection of both vertical and horizontal erect lamellae.

Figure 5. Basal view of this specimen.
Chemung group. *Wellsville, New York.*

Figure 6. The original specimen of this species, which is a nearly entire individual showing the form and size of the primary quadrules and a part of the finer reticulation.
Chemung group. *Little Genesee, Allegany county, New York.*

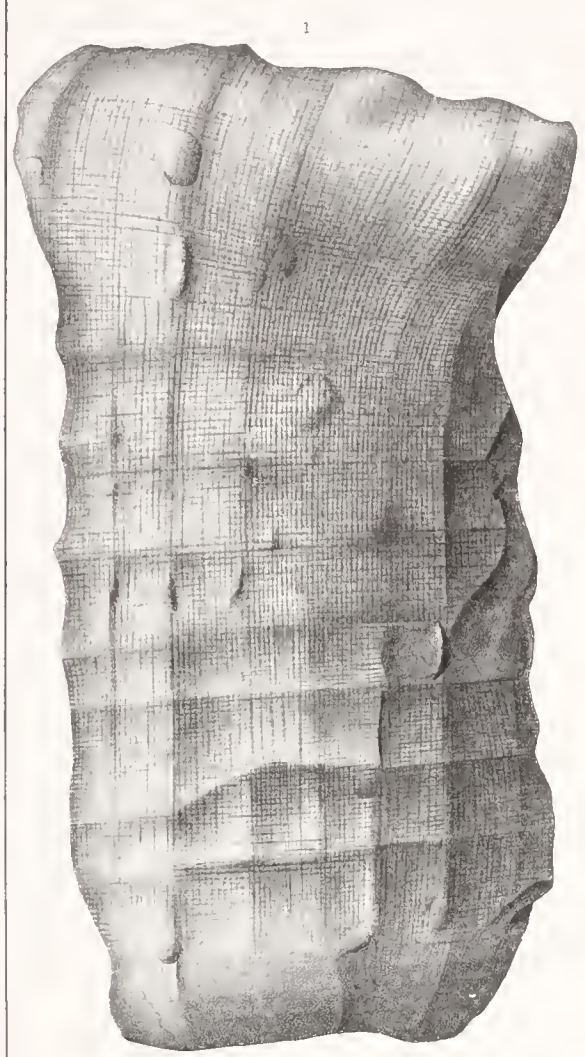
THYSANODICTYA JOHNSTONI, sp. nov.

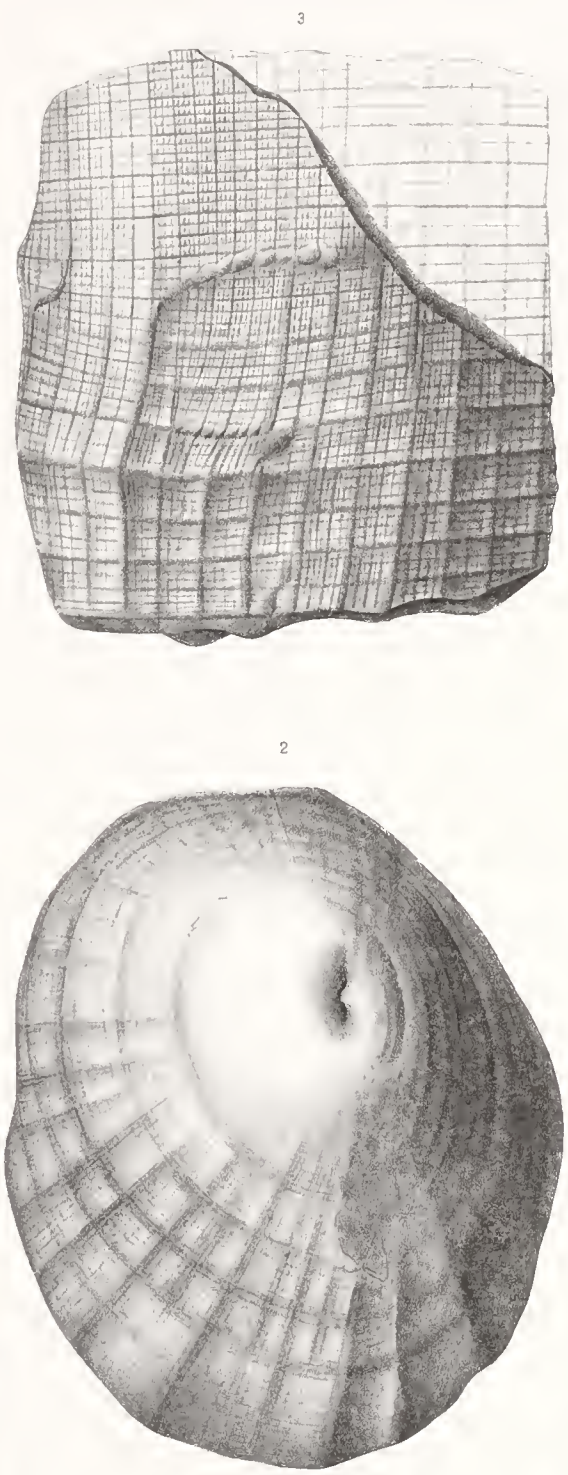
Page 130.

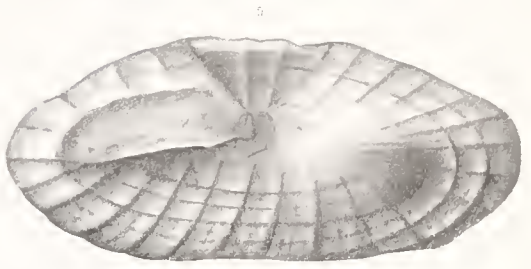
Figure 7. An entire specimen, bent upward at the base. The body of the cup is covered with low nodes of shaly matter which appears to have formed in a concretionary manner about irregularities or projections upon the surface of the reticulum. The character of the basal disk, its eccentric apex and nodose periphery are well known.

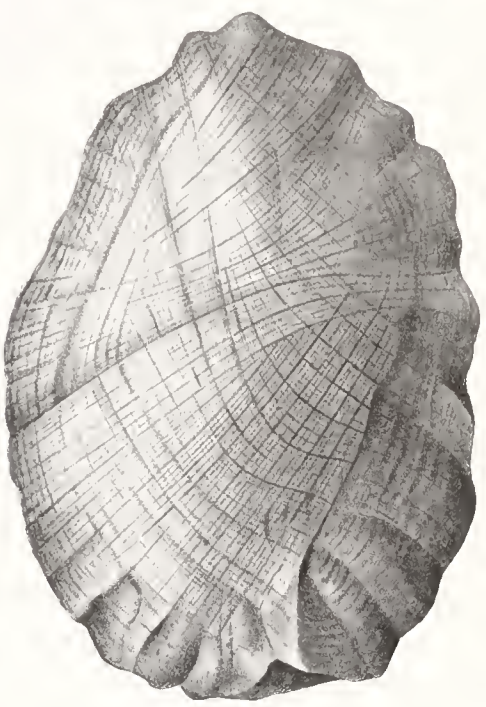
Figure 8. A basal disk with a highly irregular reticulum and without defined apex. This appears to be a normal and not accidental condition.
Chemung group. *Wellsville, New York.*

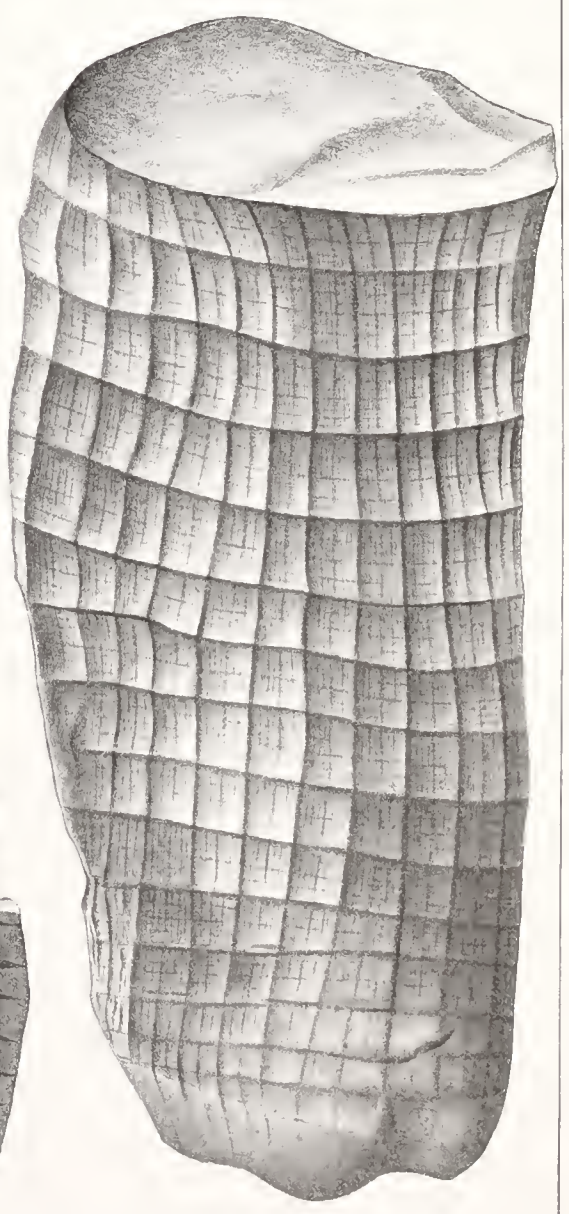
DICTYOSPONGIDÆ.

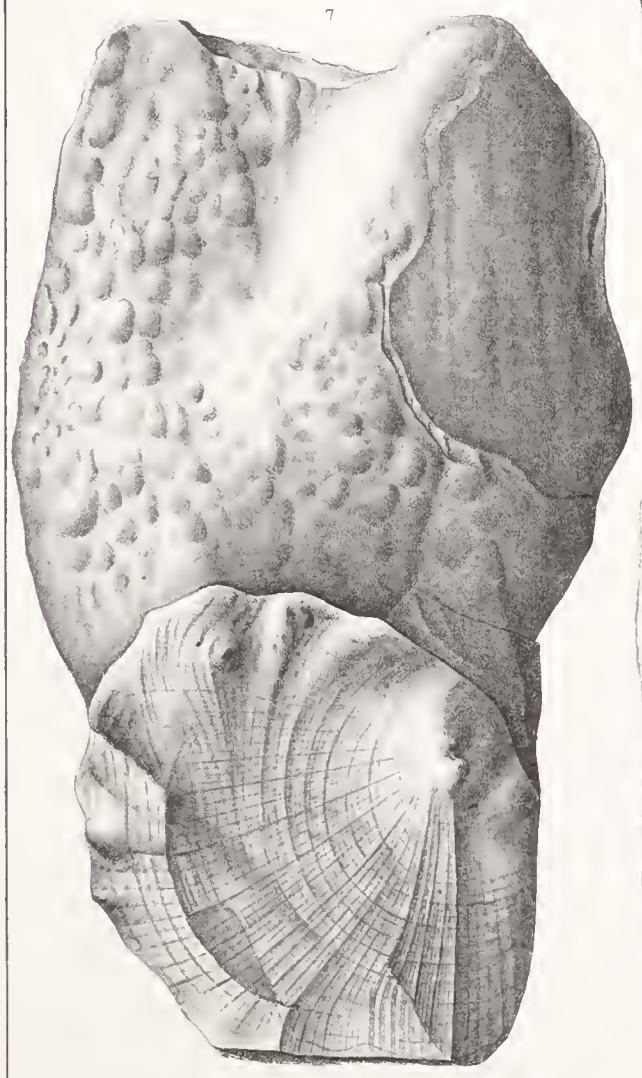












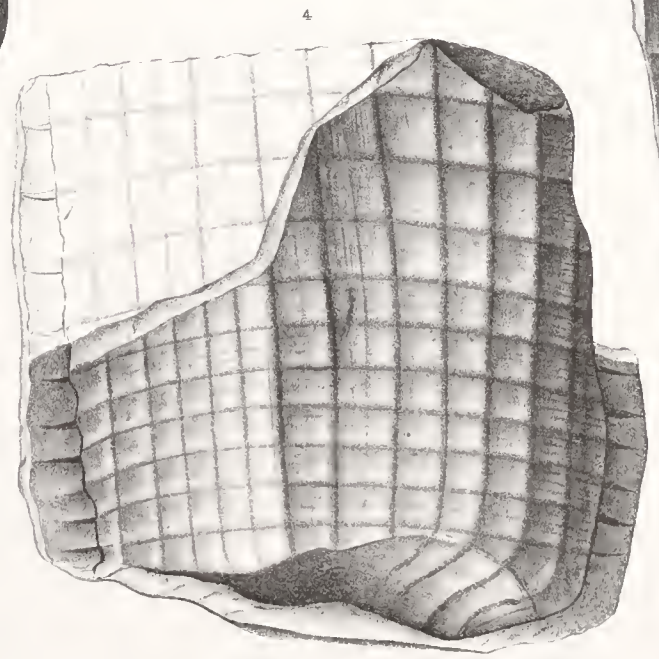


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PLATE XXIV.

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIII, XXV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA EDWIN-HALLI, nom. nov.

Page 126.

Figures 1, 2. Opposite sides of a nearly entire cup of average size; showing the broad, oblique aperture, the basal disk and the coarse primary reticulation.

Figure 3. A much more slender specimen, showing both the primary and subordinate reticulation.

Figure 4. A portion of the surface of another specimen, showing primary and secondary reticulation.

Figure 5. A small specimen exposing a part of the basal disk.

Figure 6. The lower portion of a specimen, showing the basal disk.

Figure 7. A view of the same specimen lying in its matrix and showing the broad frill at the periphery of the basal disk.

Figure 8. A flattened but essentially entire sponge in which only the strong primary quadrules are shown.

Figure 9. An incomplete specimen showing the finer reticulation. When preserved in this condition these specimens are hardly to be distinguished from internal casts of *Clathrospongia abacus* (see Plate 49, figure 8).
Chemung group. *Wellsville, New York.*

THYSANODICTYA PŒCILUS, sp. nov.

Page 127.

Figure 10. A very elongate individual, having the prevailing form of the primary quadrules nearly square; showing, also, some of the tufted intersections of the erect surface lamellae.

Figure 11. A broader individual, showing the complete outline of the body of the sponge, its aperture and base and the strong erect vertical lamellae and their intersections with similar horizontal lamellae. At the base, on one side, a portion of the basal frill is retained. Both this and the preceding specimen are preserved on the same slab in association with other forms less complete but showing less extreme outlines.
Chemung group. *Scio, Allegany county, New York.*

THYSANODICTYA RANDALLI, Hall (sp.).

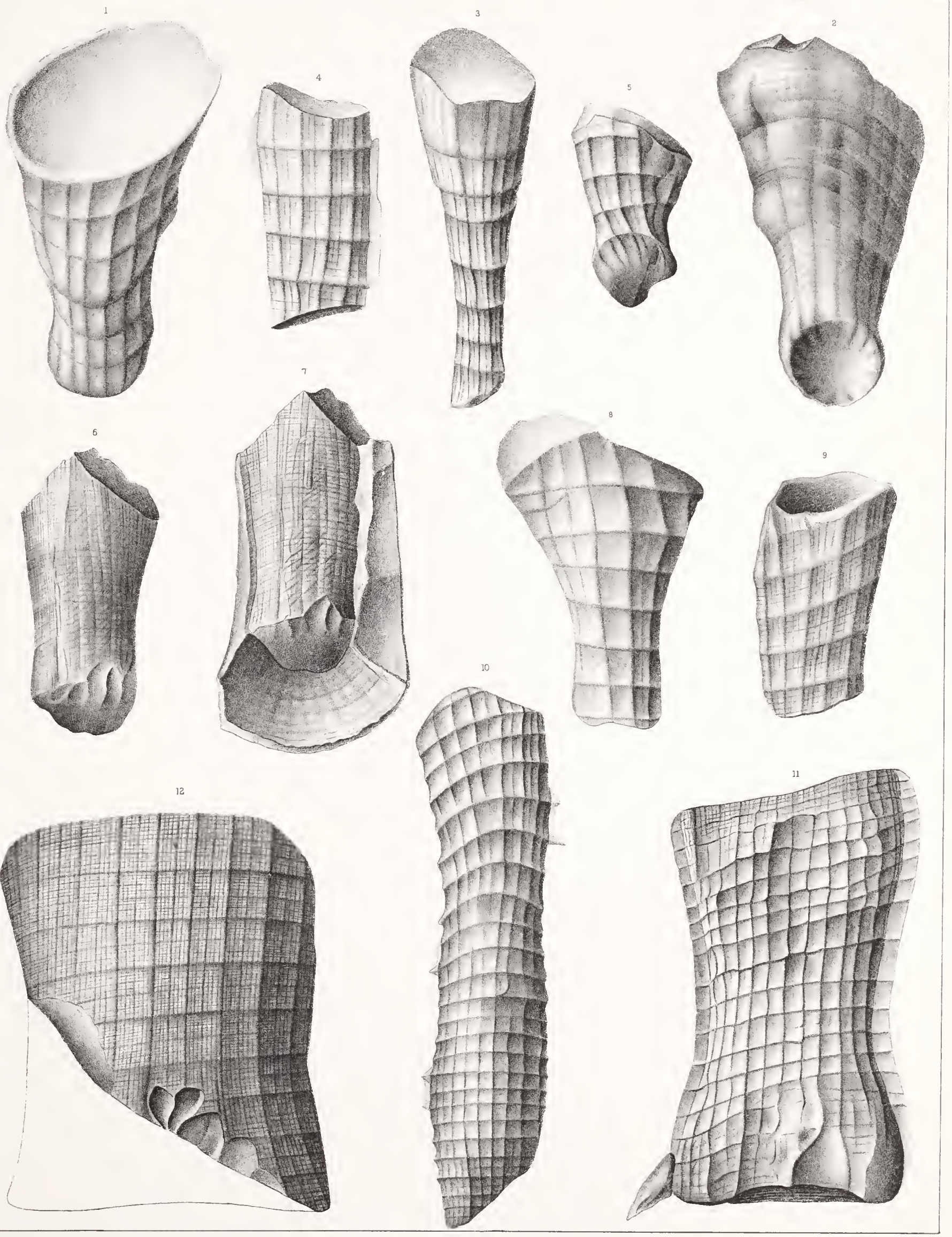
Page 129.

Figure 12. A view of the original specimen which is a fragment of the upper portion of a cup showing the character of the reticulation.
Chemung group. *Warren, Pennsylvania.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate XXIV



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Philip Ast lith

PLATE XXV.

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIII, XXIV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA SACCUS, sp. nov.

Page 130.

Figure 1. Lateral view of an entire individual showing its rapidly tapering form and contracted aperture.

Figure 2. Basal view of the same specimen which has been compressed and shows an irregular reticulum with a somewhat nodose margin.
Chemung group. *Whitesville, Allegany county, New York.*

CLATHROSPONGIA, Hall.

Page 121.

(See Plates XIV, XV, XVIII, XXI, XLIX, L.)

CLATHROSPONGIA (?) DESMIA, sp. nov.

Page 125.

Figure 3. A portion of the external surface of a species referred with doubt to this genus; showing the character of the primary quadrules.
Chemung group. *Alfred, New York.*

CLATHROSPONGIA VASCELLUM, Hall (sp.).

Page 123.

(See Plate XXI.)

Figure 4. One side of a large, somewhat waterworn fragment, with very large obscure primary quadrules and a distinct development of the subordinate spicular bands.
Chemung group. *Alfred, New York.*

CLATHROSPONGIA FENESTRATA, Hall (sp.).

Page 122.

(See Plate XIV.)

Figure 5. An internal cast of a nearly entire cup.
Chemung group. *Chemung Narrows, New York.*

DICTYOSPONGIDÆ.

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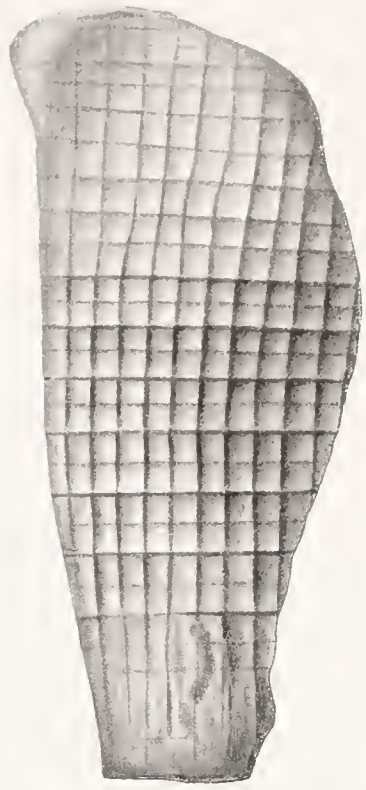

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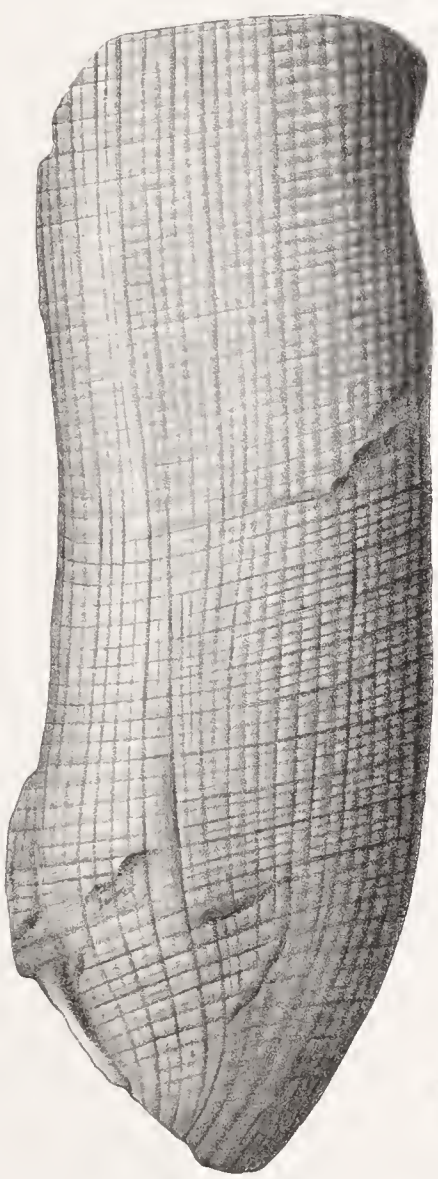

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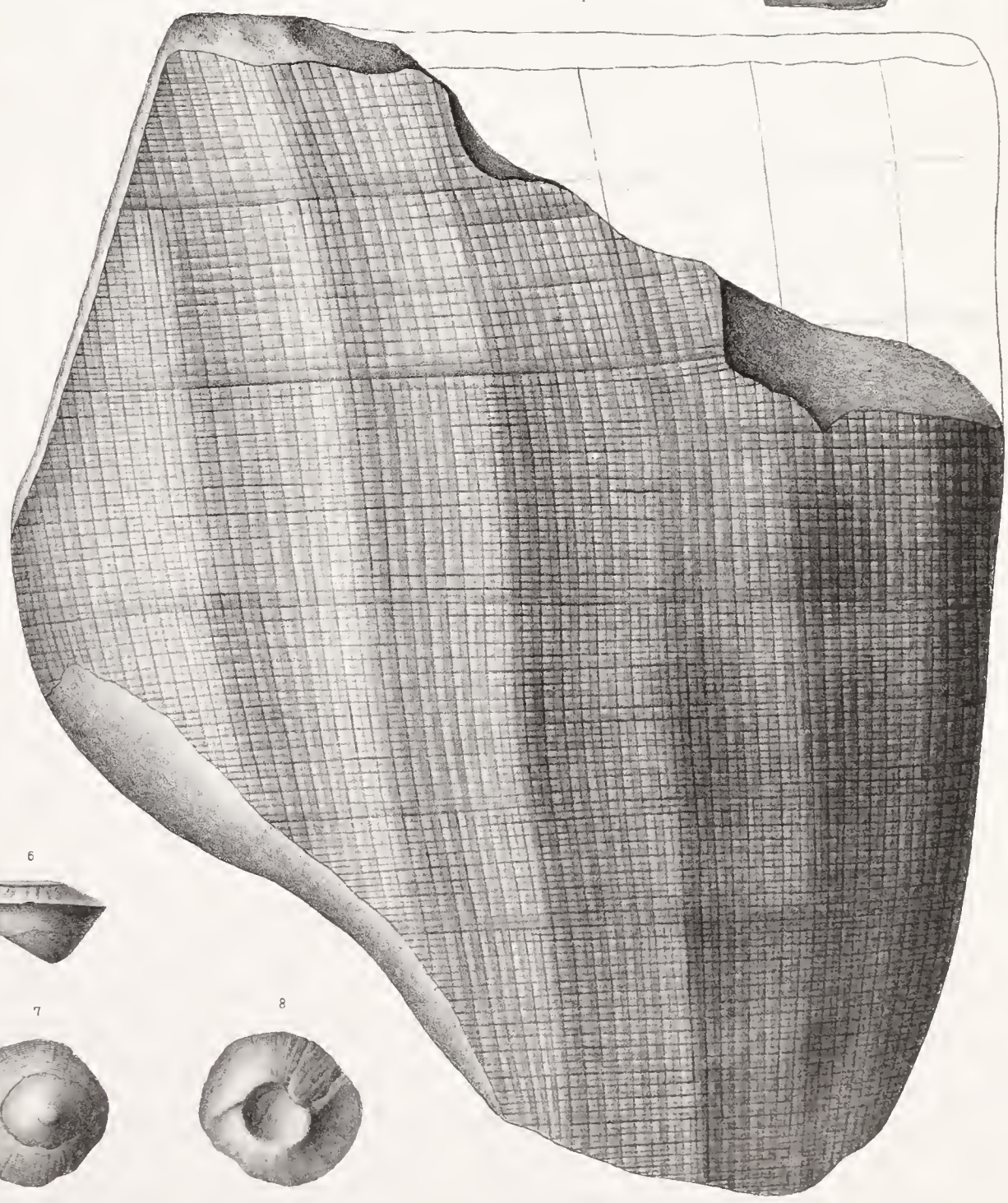

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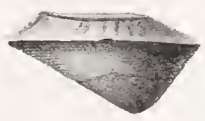

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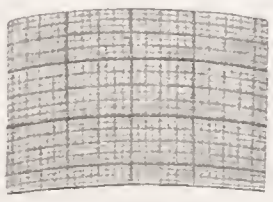

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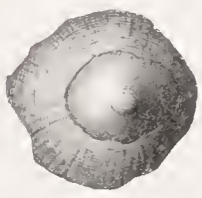

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AGLITHODICTYA, gen. nov.

Page 145.

AGLITHODICTYA NUMULINA, sp. nov.

Page 145.

Figures 6–8. Lateral, basal and apertural views of the same specimen; showing the size and peculiar form of the species, the character of the aperture with the surface canals on the oral slope, and the very fine reticulum.

Figure 9. An enlargement of the surface to show more distinctly the regular reticulations of the skeleton. x 4.

Chemung group. *Near Cohocton, Steuben county, New York.*

PLATE XXVI.

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIII, XXIV, XXV, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA APLETA, sp. nov.

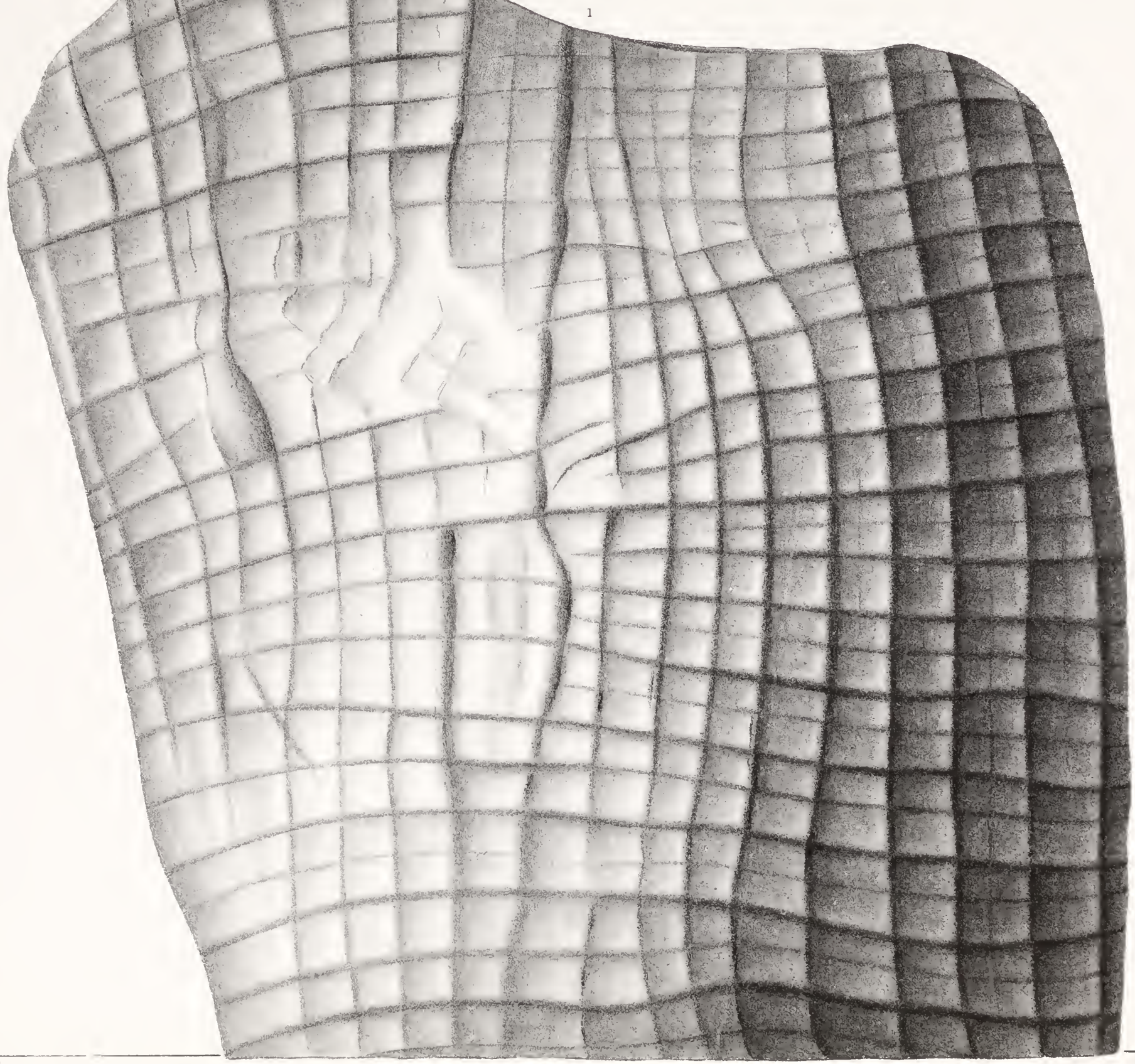
Page 135.

(See Plate XXVII.)

Figure 1. Portion of a very large specimen; drawn from a plaster cast of a natural mould.

Chemung group. *Alfred, New York.*

DICTYOSPONGIDÆ.



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Phlip Ast lith

PLATE XXVII.

HELICODICTYA, gen. nov.

Page 114.

(See Plate XXII.)

HELICODICTYA (?) SCIO, sp. nov.

Page 116.

Figure 1. A fragment of a frond which appears to have had a distinctly spiral mode of growth, with strong constrictions or impressions of ridges running parallel to one of the reticulating series.

Chemung group. *Scio, Allegany county, New York.*

HELICODICTYA (?) CONCORDIA, sp. nov.

Page 115.

Figure 2. A spirally growing sponge found associated with *Prismodictya prismatica* in the

Chemung group. *Concord station, Erie county, Pennsylvania.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

Page 73.

(See Plates XIV, XV, XVI, XXXVI.)

Figure 3. A small incomplete, somewhat compressed example with very fine reticulation.

Chemung group. *Wellsville, New York.*

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XX, XXI, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA FILITEXTILIS, Hall (sp.).

Page 86.

(See Plate XXI.)

Figure 4. A fragment of an uncompressed individual showing the obscure prism-faces and fine reticulation.

Chemung group. *Wellsville, New York.*

DICTYOSPONGIDÆ.

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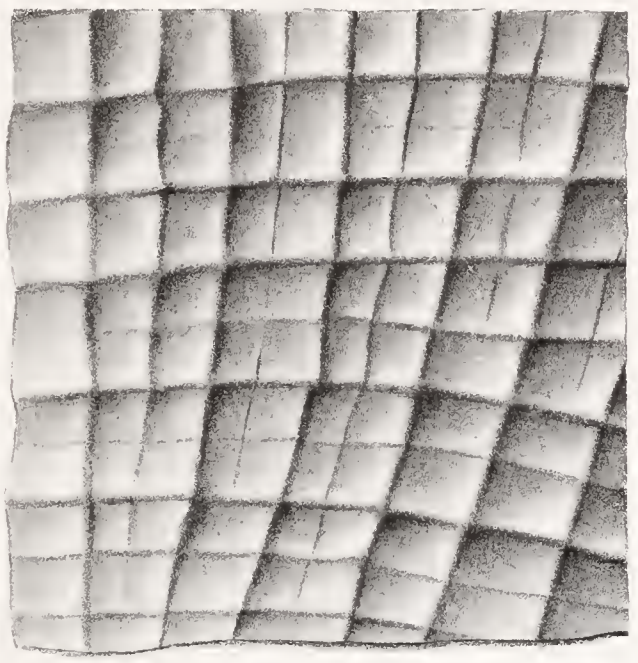

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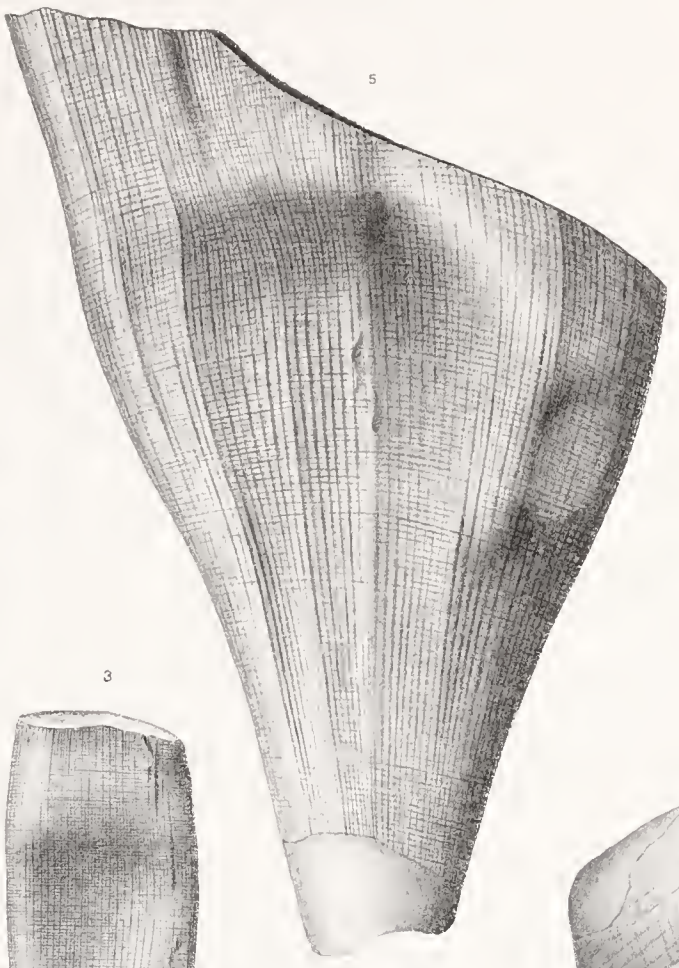

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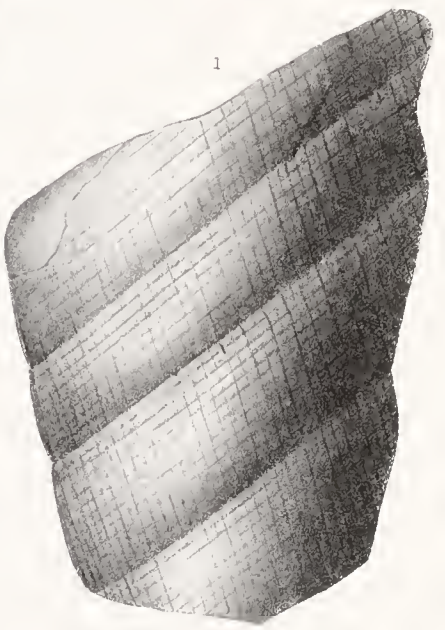

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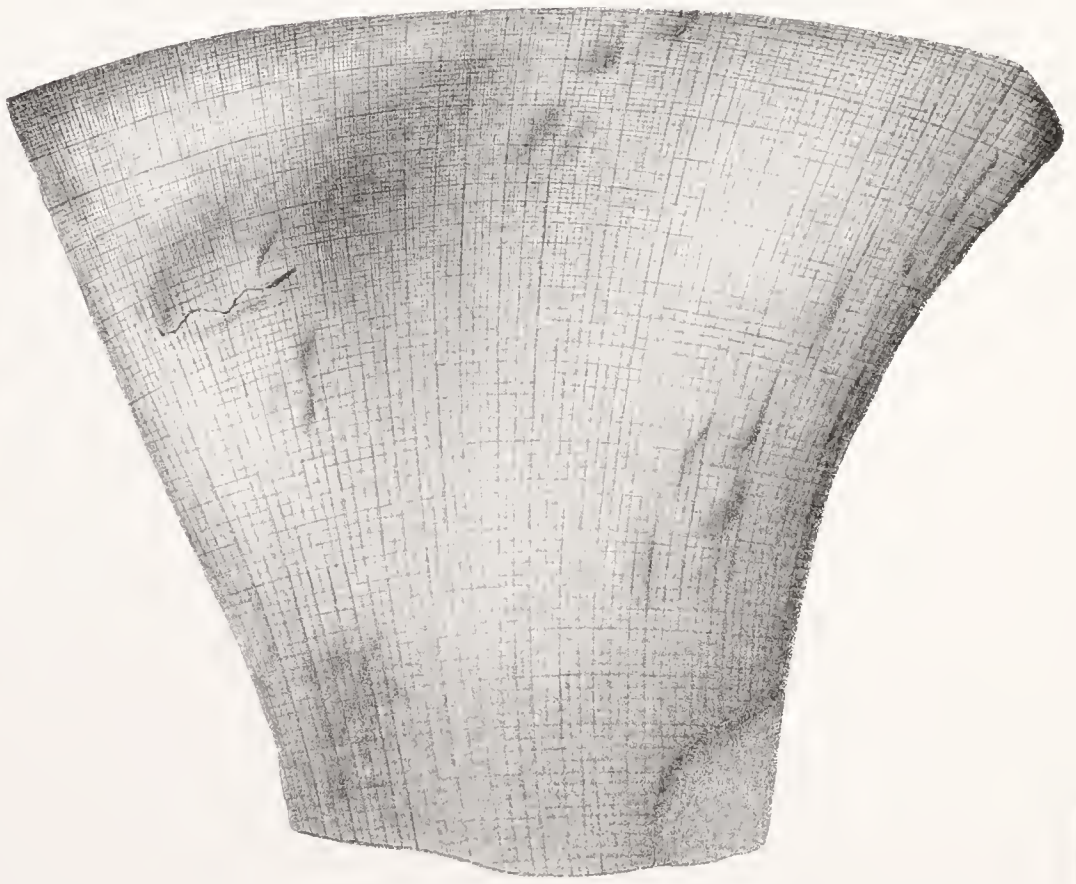

PRISMODICTYA CHOANEA, sp. nov.

Page 85.

(See Plates XIX and XXXV.)

Figure 5. The lower portion of a large cup showing obscurely prismatic faces.

Chemung group. *Ischua, Cattaraugus county, New York.*

DICTYOSPONGIA? (ECTENODICTYA?).

Figure 6. A flat and expanded portion of a frond, whose outline may represent the original form of the cup, although the edges appear to be somewhat ragged. The reticulation is very fine and the surface without evidence of prism-faces. The specific and generic relations of the specimen are uncertain.

Chemung group. *Wellsville, New York.*

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA HERMENIA, sp. nov.

Page 133.

(See Plates XXXIX and XL.)

Figure 7. The surface of an incomplete individual; showing the very strong primary bands and large quadrules. No evidence is retained of subordinate reticulation but the surface of the specimen has been involved in shale and the structure obscured. The drawing is made from a plaster-cast of a natural mould of the exterior.

Chemung group. *Alfred, New York.*

THYSANODICTYA APLETA, sp. nov.

Page 135.

(See Plate XXVI.)

Figure 8. A fragment of the surface, showing the coarse primary and secondary quadrules.

Chemung group. *Alfred, New York.*

PLATE XXVIII.

HYPHANTÆNIA, Vanuxem.

Page 137.

(See Plates XXIX and XLV.)

HYPHANTÆNIA CHEMUNGENSIS, Vanuxem.

Page 139.

(See Plates XXIX and XLV.)

Figure 1. An internal cast of the central or basal portion of a frond, showing the concentric and radiating ligulate bands and the open quadrate interspaces.

Figure 2. A view of the original specimen described and figured by Vanuxem. This shows the strongly elevated margins of the radial bands which are maintained at the intersections of these with the concentric bands.

Chemung group. *In the vicinity of Owego, Tioga county, New York.*

DICTYOSPONGIDÆ.

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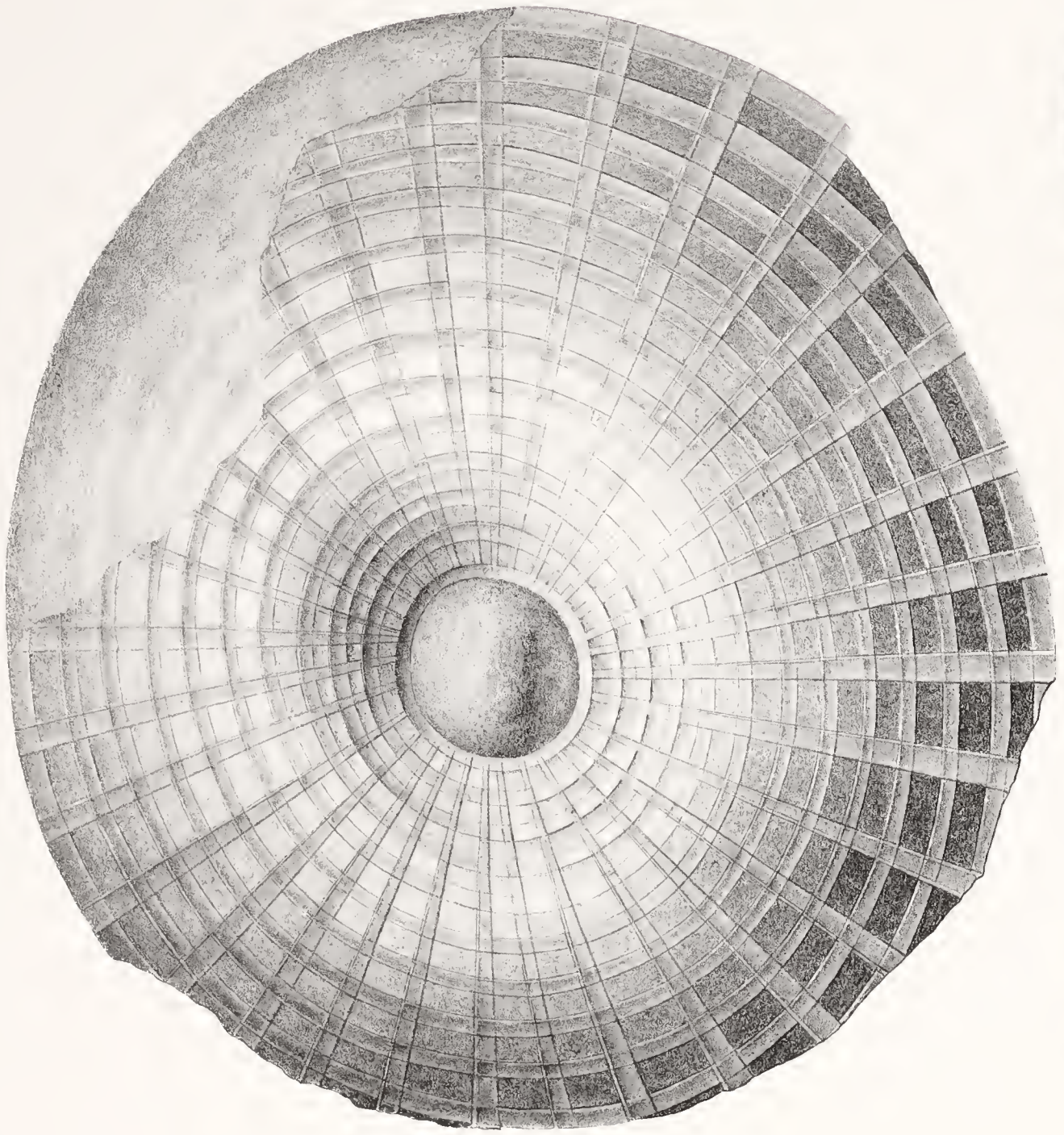

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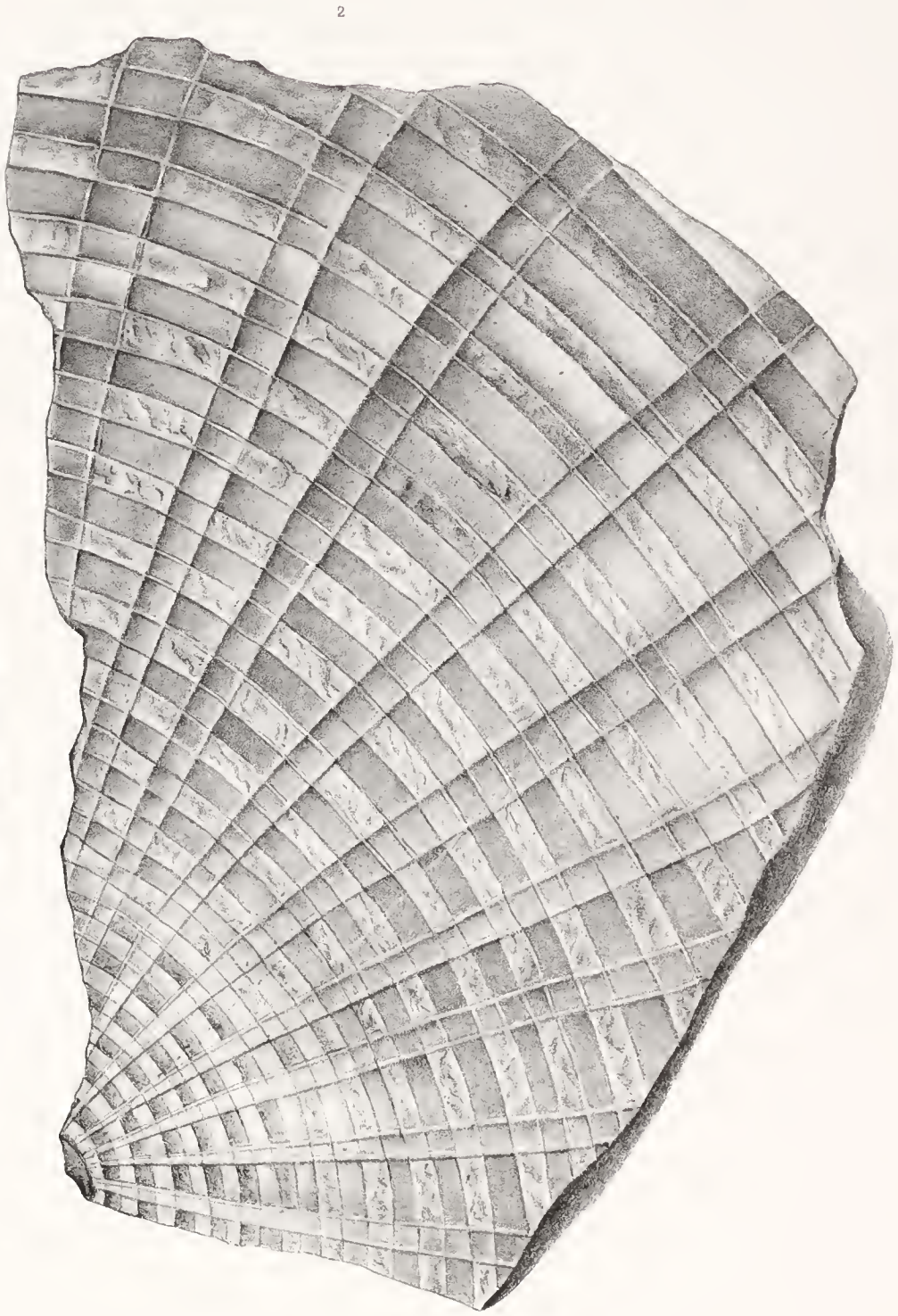

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PLATE XXIX.

HYPHANTÆNIA, Vanuxem.

Page 137.

(See Plates XXVIII and XLV.)

HYPHANTÆNIA CHEMUNGENSIS, Vanuxem.

Page 139.

(See Plates XXVIII and XLV.)

Figure 1. A fragment of a specimen whose entire diameter is probably represented. This appears to be a mould from an impression of the exterior, shows the expanding saucer-shaped form of the sponge, the rapid increase in the width of the radial bands, also their elevated margins and the open quadrangular interspaces made by the intersection of the two series of bands. The center of the specimen as well as that represented in figure 1 on the preceding plate lacks definition and lends probability to the inference that there was a tuft of basal spicules at this point.

Chemung group. *Near Owego, Tioga county, New York.*

DICTYOSPONGIDÆ.

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Plate XXIX

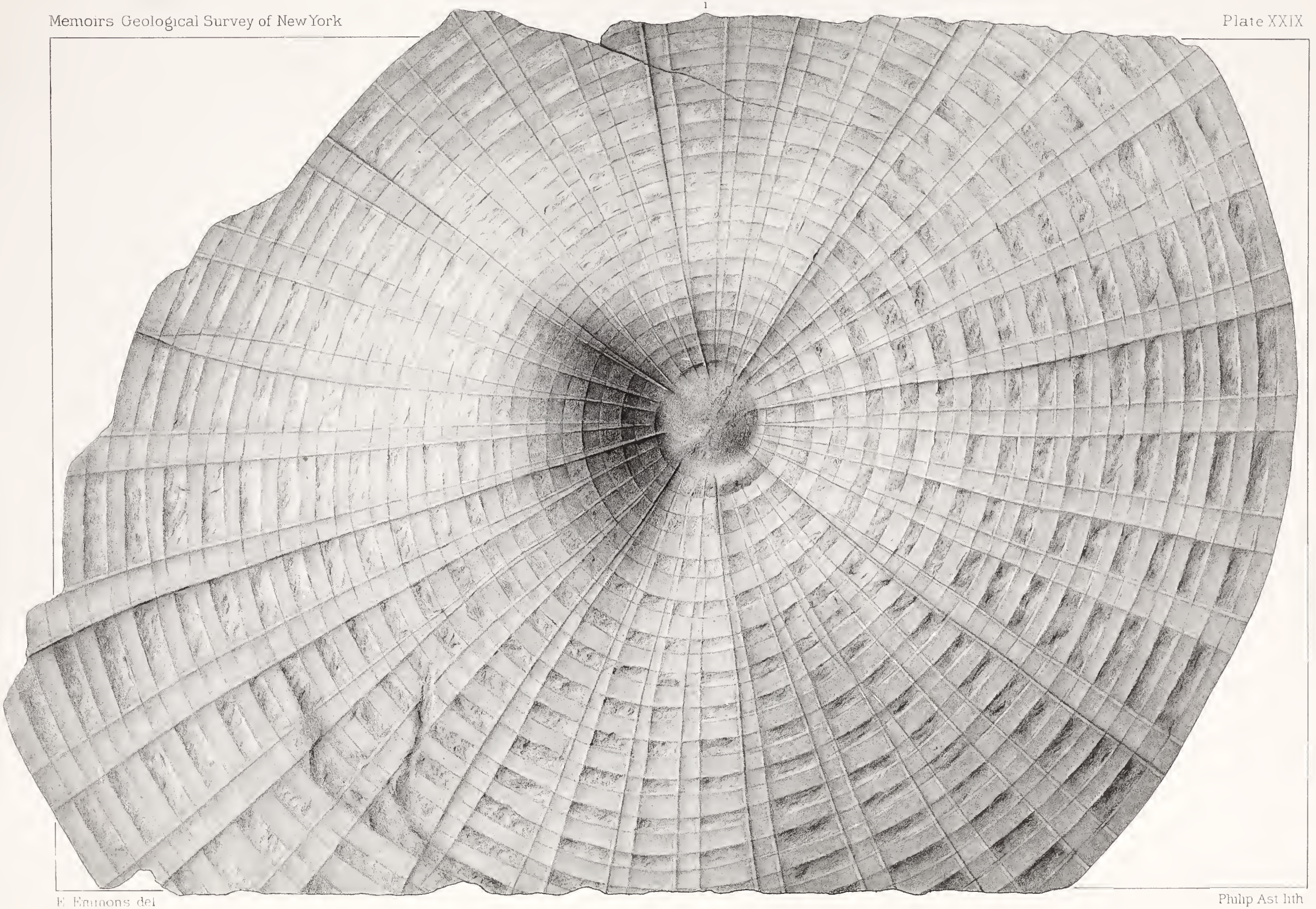

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PLATE XXX.

ACTINODICTYA, Hall.

Page 142.

(See Plate XXXI.)

ACTINODICTYA PLACENTA, Hall.

Page 143.

(See Plate XXXI.)

Figure 1. An irregularly oval frond showing great differences in the size of the spicular bands. In this specimen these bands show an unusually regular reticulation although the various series may intersect at different angles. The drawing has been made with accuracy but the apparent abundance of cruciform spicules is wholly due to elevation of reticulating spicular bands at and near their intersections; as these bands gradually die out, the more strongly projecting portions produce the effect observed.

Figure 2. Two essentially entire fronds, one partially overlapping the other and somewhat broken near one extremity. This specimen with that represented in figure 1 and that in figure 1 on Plate xxxi show the form of this fossil at the locality where it has been found in the greatest perfection and without evidence of much distortion. Such specimens indicate that the bodies were broad, convex expansions, evidently not of highly irregular growth but with a definite marginal outline and uboval form.

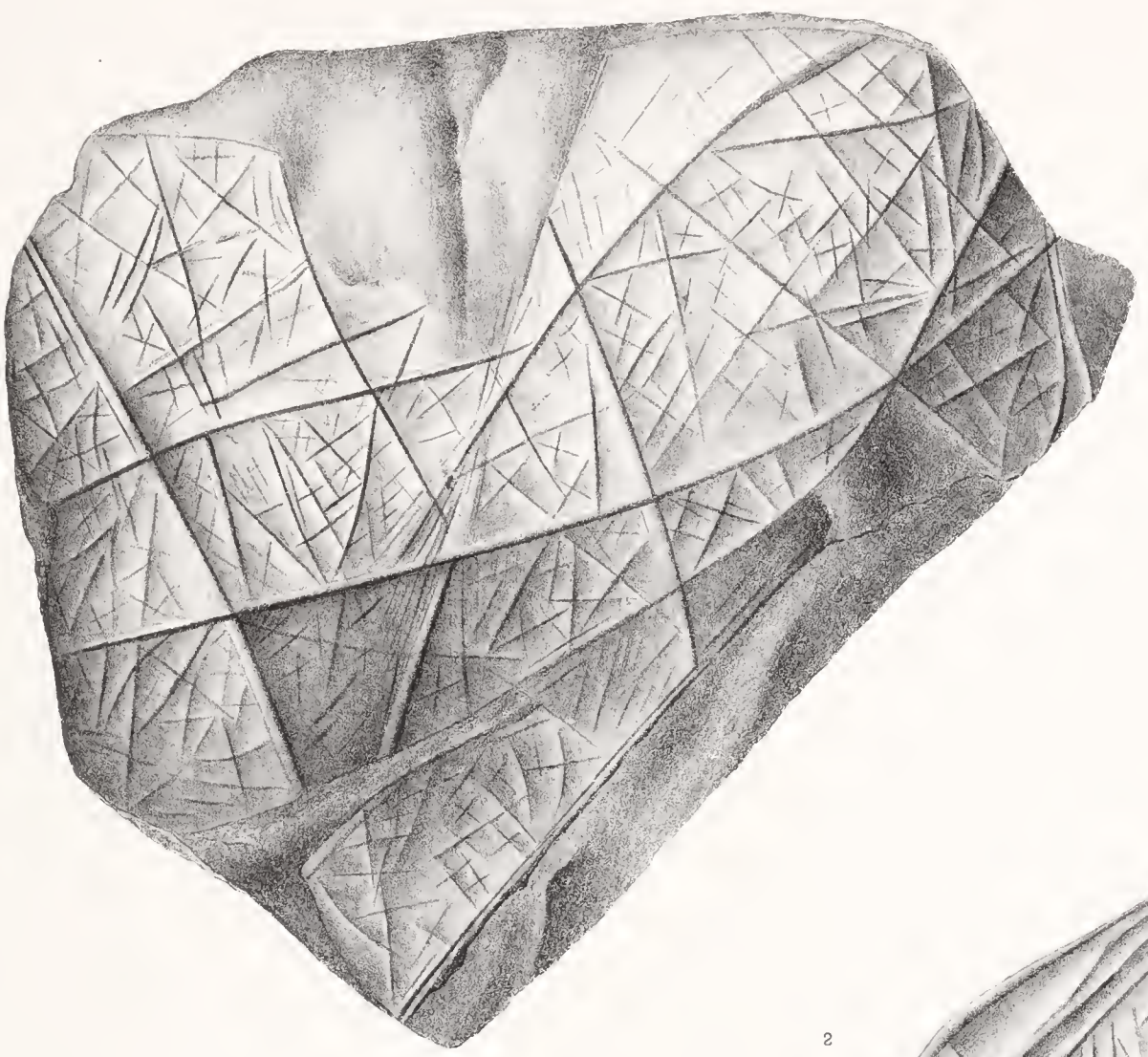
Chemung group. *One-half mile from Brown hill, near Cohocton, New York.*

Figure 3. A fragment of a specimen the surface of which bears irregularly scattered spots representing subcircular perforations of the spicular net-work. These may be to some extent due to accident.

Chemung group. *Near Howard, New York.*

DICTYOSPONGIDÆ.

1



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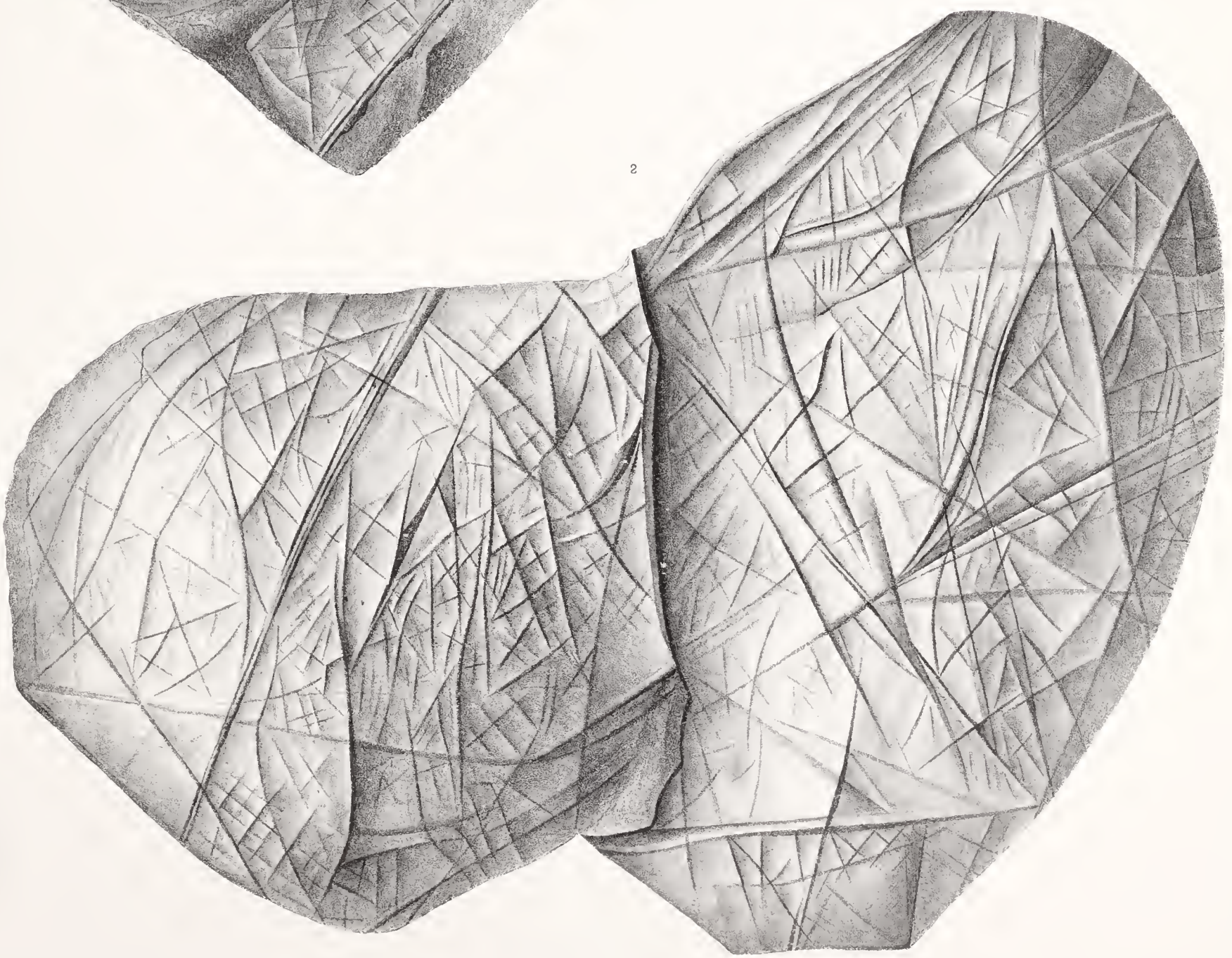

PLATE XXXI.

ACTINODICTYA, Hall.

Page 142.

(See Plate XXX.)

ACTINODICTYA PLACENTA, Hall.

Page 143.

(See Plate XXX.)

Figure 1. A very nearly complete frond showing the regularity of much of the finer reticulation.

Chemung group. *One-half mile from Brown hill school house near Cohocton, New York.*

Figure 2. A small frond, with well defined margins indicating completed peripheral growth.

Chemung group. *Brown hill colony, near Cohocton, New York.*

CRYPTODICTYA, Hall.

Page 144.

(See Plate XXXII.)

CRYPTODICTYA ALLENI, Hall.

Page 144.

(See Plate XXXII.)

Figure 3. A portion of a nodose margin of a specimen which shows that these nodes bore tufts of spicules. Such tufts are seen only when the nodes lie at the margins of the surface expansion and the tufts extend along the plane of lamination of the matrix.

Figure 4. An irregular frond showing on one side the abrupt depression of the nodose surface to the broad, anodose marginal expansion.

Figure 5. A large specimen in which the nodes are arranged in groups. This frond has been folded along the right margin, the opposite side being of the same extent as that here represented, and having the nodes similarly arranged in clusters. This folding of the frond is, however, probably wholly due to compression.

Chemung group. *Lyndon, Cattaraugus county, New York.*

DICTYOSPONGIDÆ.

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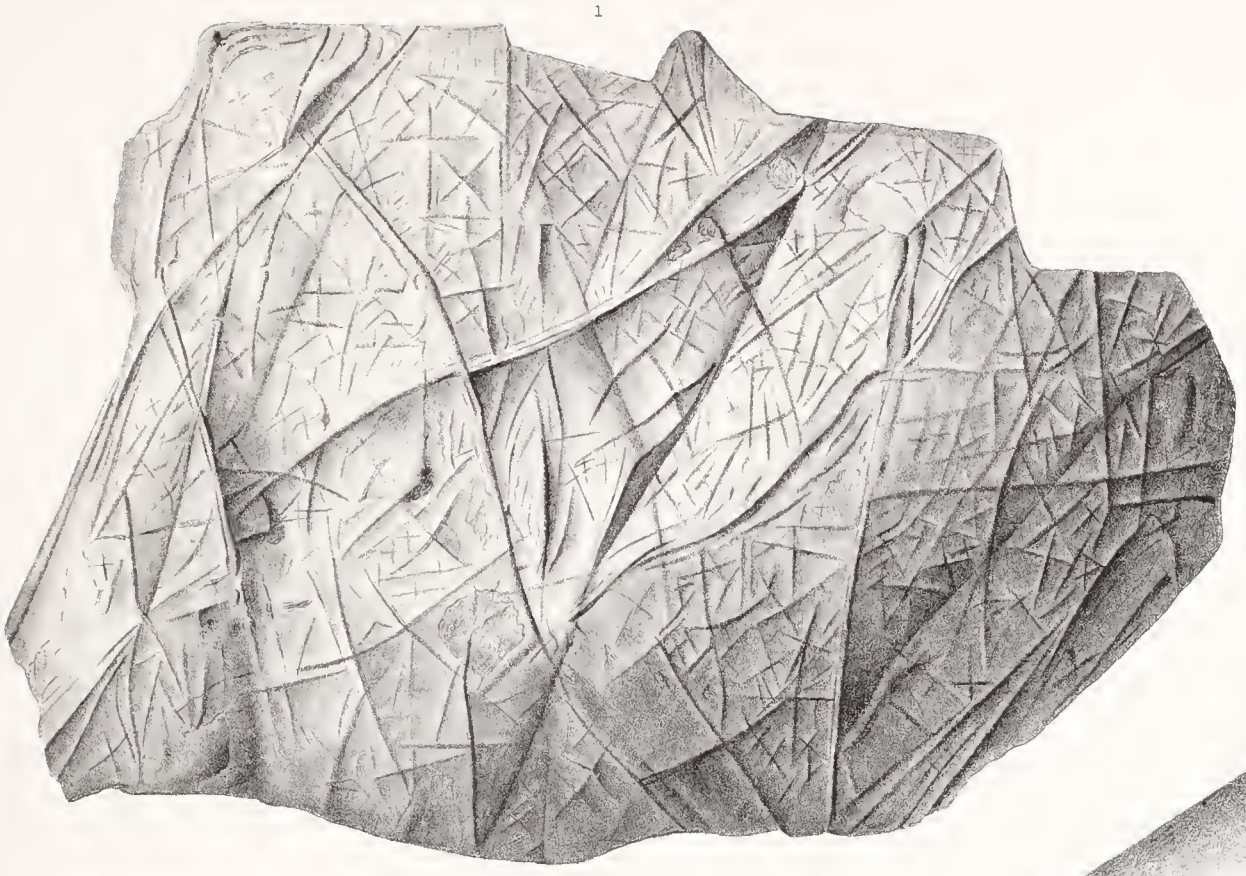
Plate XXXI.

1



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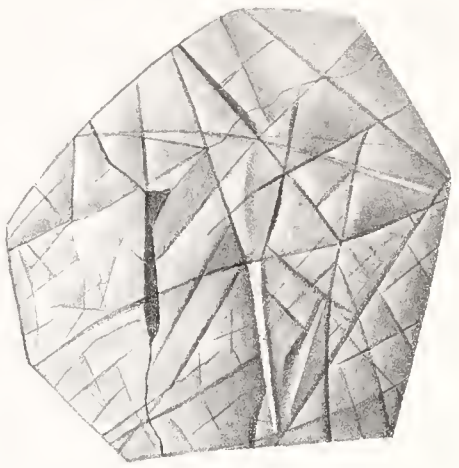

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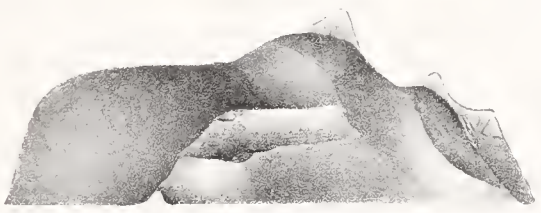

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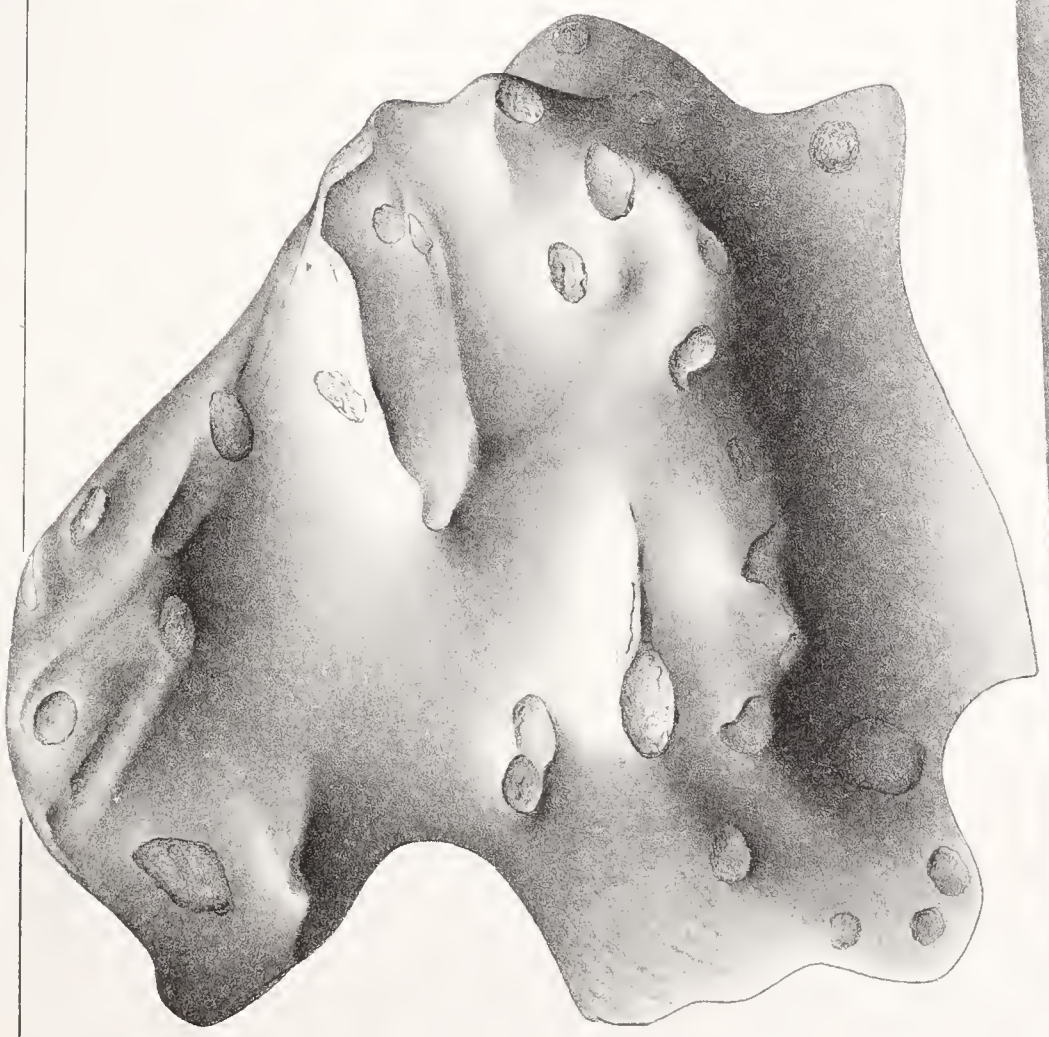

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G.B Simpson del

Philip Ast lith

PLATE XXXII.

CRYPTODICTYA, Hall.

Page 144.

(See Plate XXXI.)

CRYPTODICTYA ALLENI, Hall.

Page 144.

(See Plate XXXI.)

Figure 1. The nodose portion of a large specimen. This appears to have been a lateral or extremital portion of a frond where the surface is marked by oblique angular curved ridges terminating in swollen nodose elevations. Several of these ridges show coarse lines or grooves radiating from the summit, and over the broad general slope of the surface as well as between the ridges are seen traces of spicular lines.

Figure 2. A small fragment representing a partially enfolded, narrow portion of a frond, bearing a divided node on the surface.

Figure 3. A specimen of subclavate outline, exhibiting the flattened nodose surface, the sides falling away vertically in all directions, except below. These specimens all indicate that the original form of the frond was a suboval expansion having a slight elevation, a nodose upper or expanded surface and probably was attached by the free margins or by the narrowed extremity.

Figure 4. A somewhat similar portion of a frond showing the irregularly nodose surface. The margins of the expansion are bent vertically downward on all sides except the posterior and the specimen appears to be the elevated and flattened surface of the frond.

Chemung group. *Near Lyndon, Cattaraugus county, New York.*

DICTYOSPONGIDÆ.

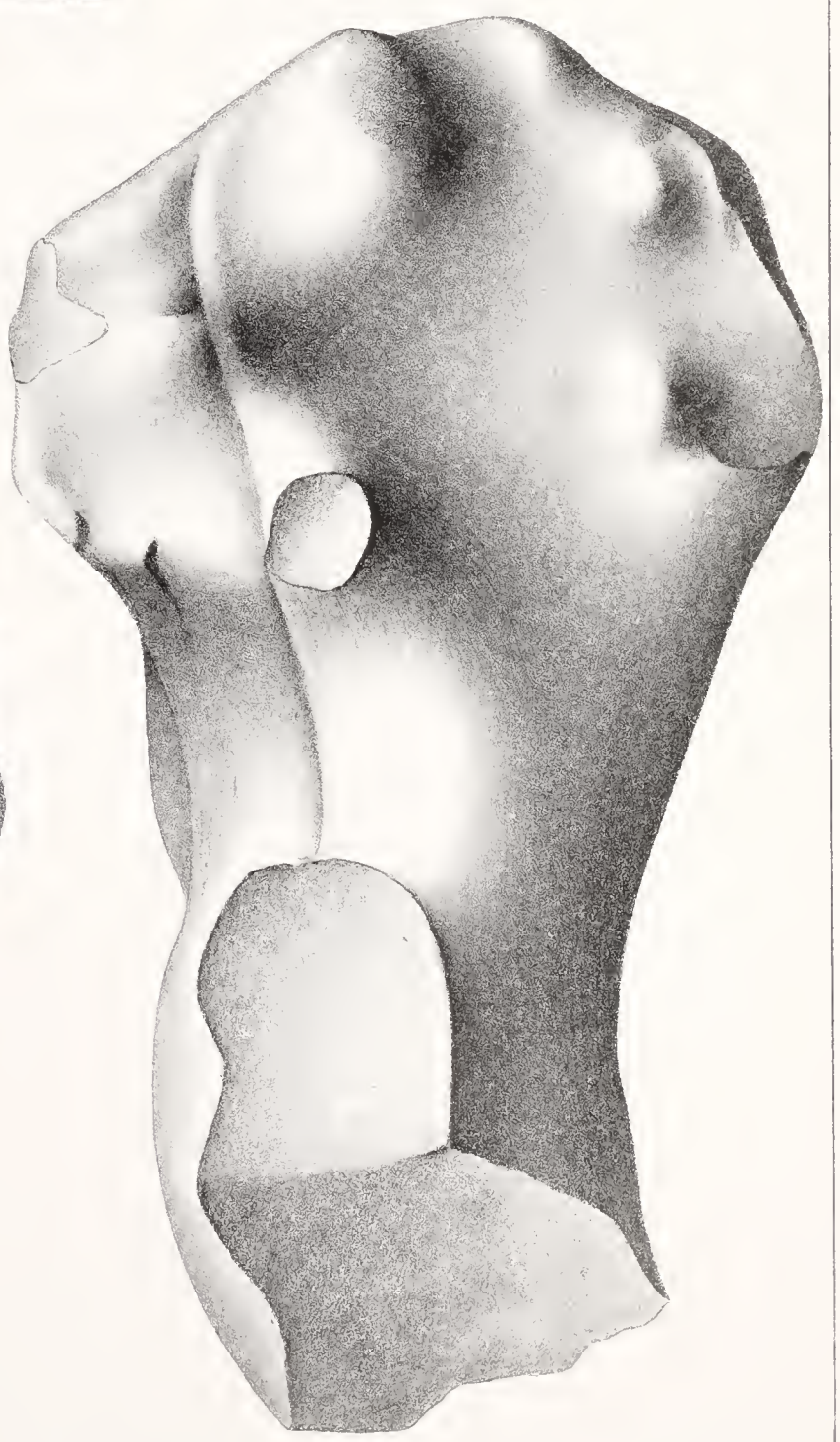

PLATE XXXIII.

DICTYSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA HAPLEA, sp nov.

Page 68.

Figure 1. The larger and more complete of the specimens observed; showing the smooth non-prismatic surface and a contraction of diameter near the aperture.

Portage group. *Naples, New York.*

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA PALÆA, sp. nov.

Page 69.

Figure 2. The original specimen; a nearly entire individual showing faint prism-faces and indications of low horizontal depressions.

Portage group. *Naples, New York.*

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS GRACILE, sp. nov.

Page 70.

Figures 3, 4. Two specimens, entire in the extent of the cup from base to aperture, but foreshortened by vertical compression. They show three horizontal rows of nodes with traces of incipient nodes near the aperture.

Portage group. *Varysburg, New York.*

HYDNOCERAS LEGATUM, sp. nov.

Page 69.

Figure 5. A specimen of medium size with apex preserved and bearing three horizontal rows of nodes.

Portage group. *Naples, New York.*

Figure 6. Fragment of a very large example with broad nodes, similar to those in *H. Avoca.*

Portage group. *Varysburg, New York.*

DICTYOSPONGIDÆ.

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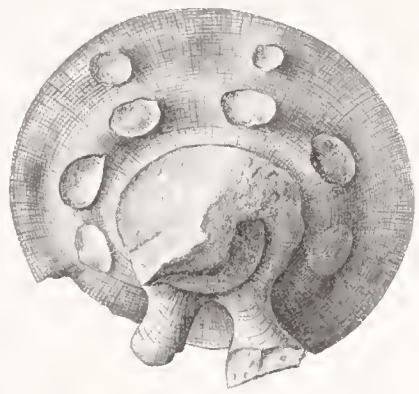

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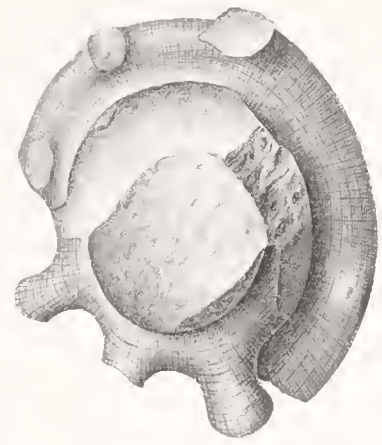

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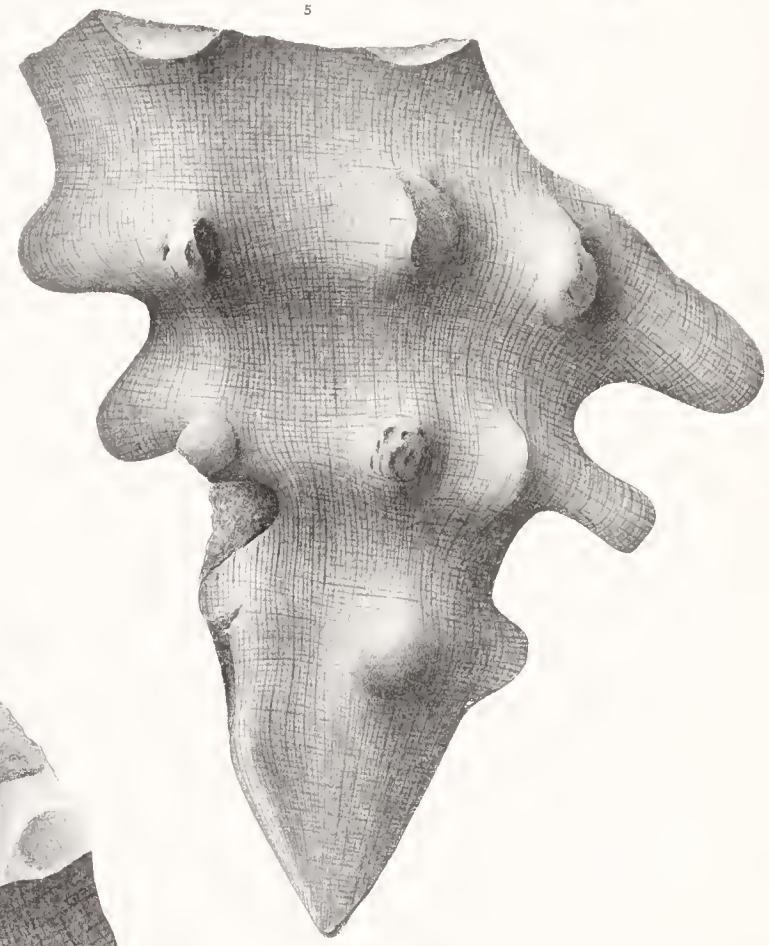

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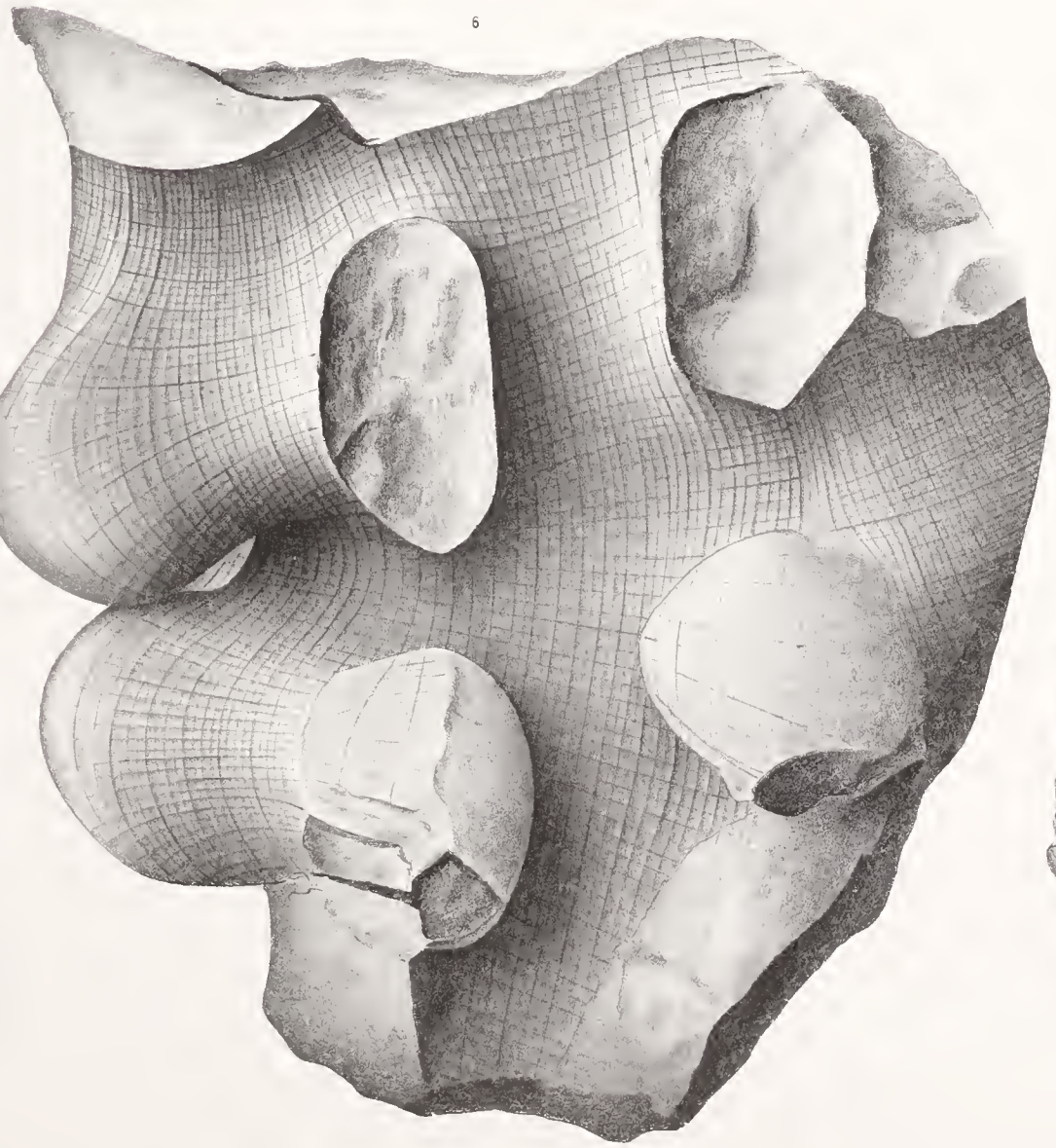

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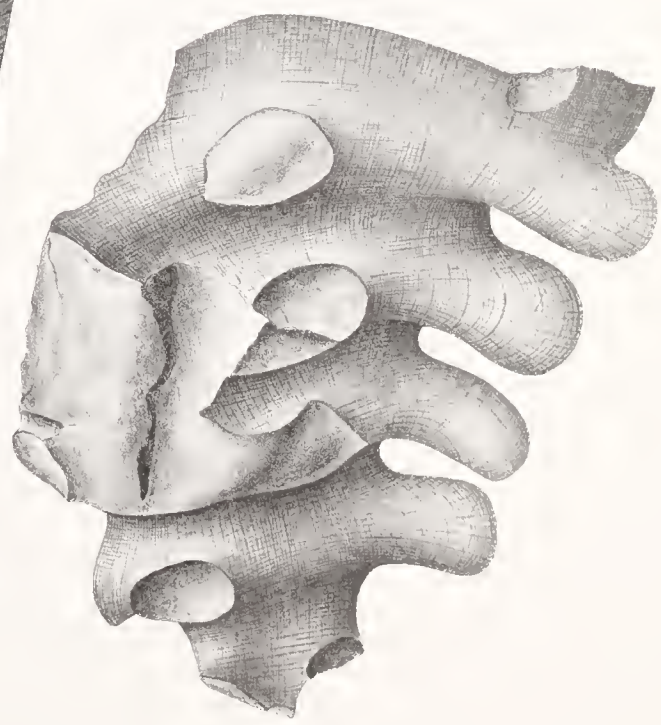

HYDNOCERAS EUTHELES, sp. nov. (?)

Page 70.

(See Plate VIII.)

Figure 7. A fragment with elongated, subpendulous nodes, similar to those shown in the figures of this species on Plate viii (figs 5 and 6).
Portage group. *Varysbury, New York.*

HYDNOCERAS ANTHRACIS, sp. nov.

Page 109.

(See Plates II and VI.)

Figures 8, 9. Opposite sides of the most complete example observed; showing the sharply prismatic anodate lower half of the sponge and the three horizontal rows of low nodes of the upper half lying on, and ridged by the prism-angles.
Chemung group. *Scio, New York.*

PLATE XXXIV.

CLEPSYDROSPONGIA, gen. nov.

Page 71.

CLEPSYDROSPONGIA MATUTINA, sp. nov.

Page 71.

Figures 1, 2. Opposite sides of the original specimen; showing the subequal expansion of the extremities and the contracted median nodose area. Figure 1 is drawn from the specimen as it lies in its matrix and shows the node-tufts even at spots where no nodes are clearly developed on the surface.

Portage group. *Naples, New York.*

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA PTIONIA, sp. nov.

Page 88.

Figure 3. The original specimen showing its great expansion near the middle and its concave prism-faces.

Chemung group. *Scio, New York.*

PRISMODICTYA AULOPHIA, sp. nov.

Page 88.

(See Plates XX and XLI.)

Figures 4, 5. Two specimens; showing the elongate form and concave faces. These specimens are from a fragment of rock which contains traces of numerous other individuals of this species.

Chemung group. *Scio, New York.*

DICTYOSPONGIDÆ.

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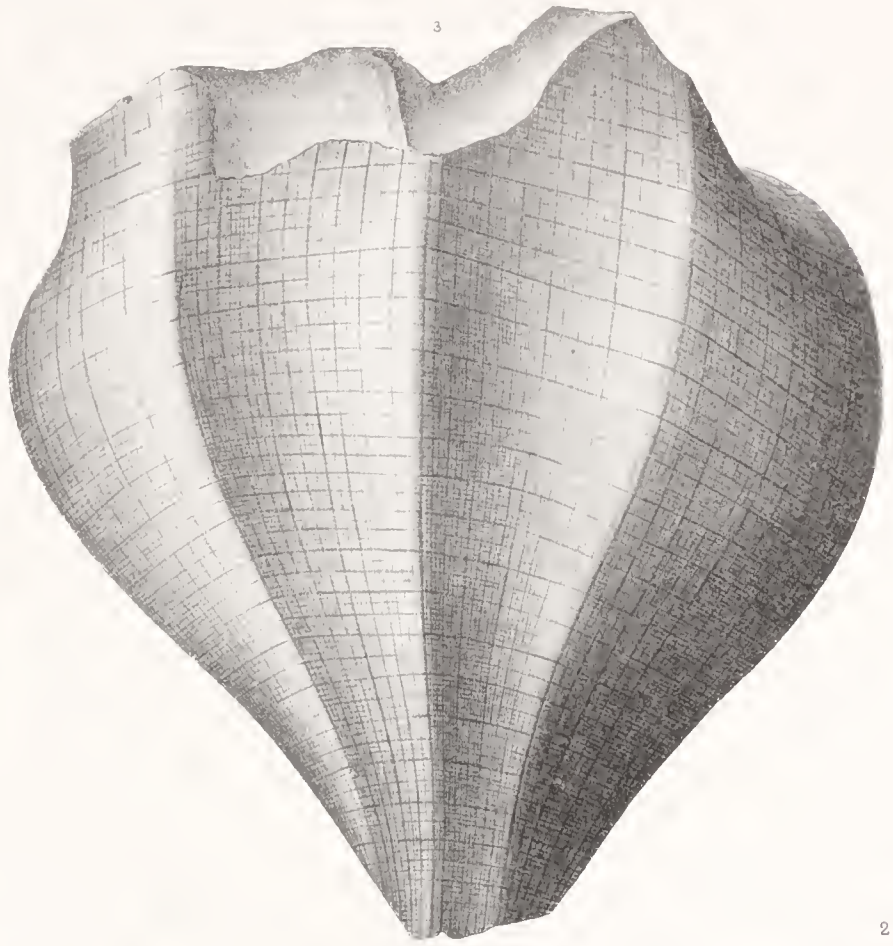

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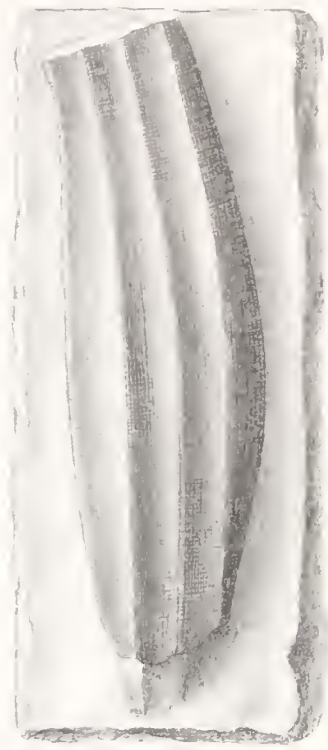

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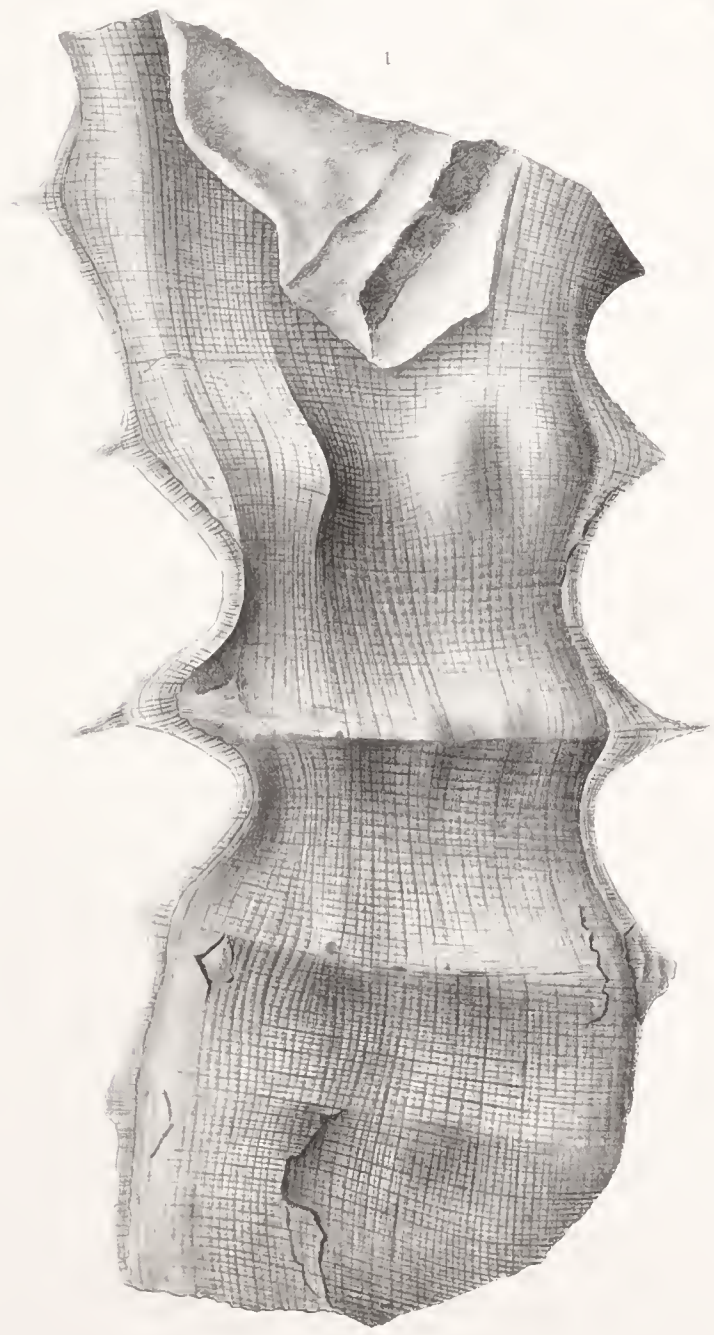

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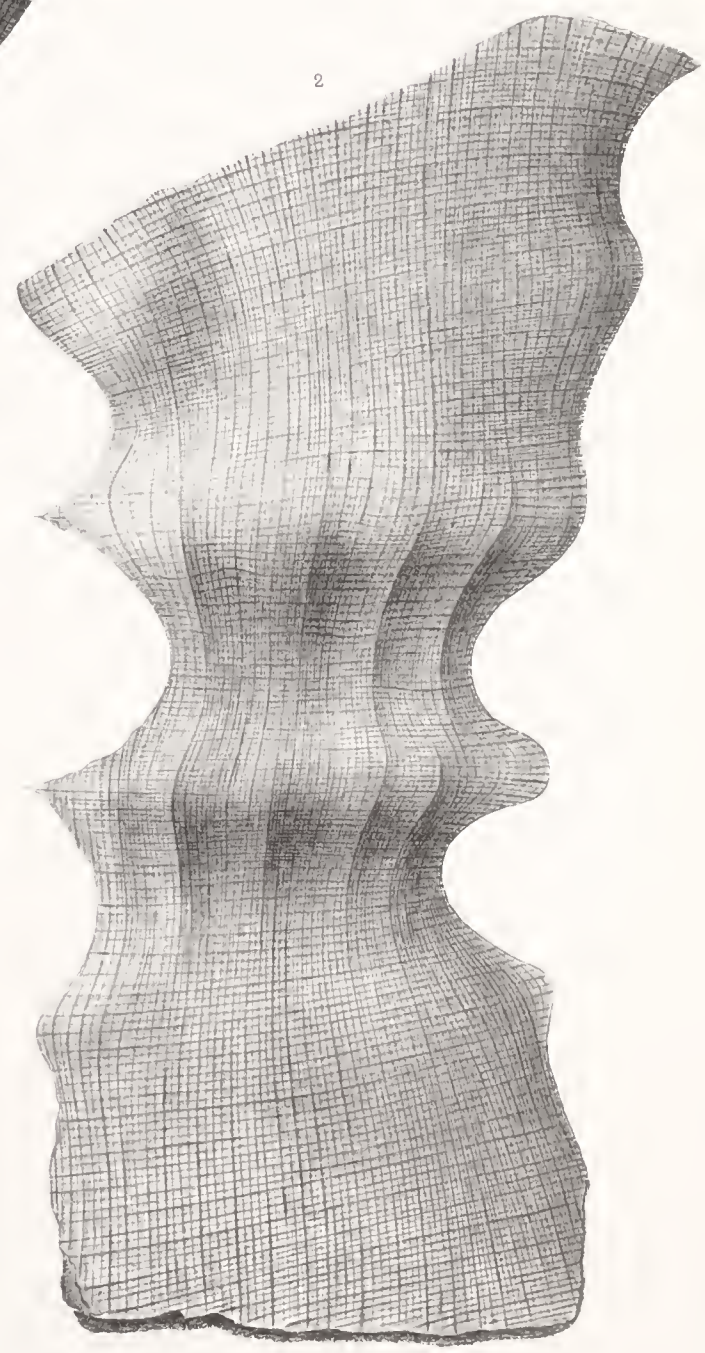

G.B. Simpson del.

Philip Ast lith

PLATE XXXV.

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA CITHARA, sp. nov.

Page 90.

(See Plate XXXVI.)

Figures 1, 2. Opposite sides of the same specimen, complete at the aperture but imperfect toward the base; showing the abrupt expansion of the cup in the upper part of the sponge, with low nodes at the elevated portions of the prism-angles.

Figure 3. Another specimen showing similar characters.

Chemung group. *Scio, New York.*

PRISMODICTYA NARTHECIA, sp. nov.

Page 90.

Figures 4, 5. Two views of the typical specimen, an elongate and slender sponge with but slight expansion above the middle.

Chemung group. *Scio, New York.*

PRISMODICTYA CHOANEA, sp. nov.

Page 85.

(See Plates XIX and XXVII.)

Figure 6. Fragment of a large individual with low prism-faces (too strongly rendered in the drawing).

Chemung group. *Olean, New York.*

PRISMODICTYA TELUM, Hall (sp.).

Page 80.

(See Plates XVII and XLII.)

Figures 7, 8. Two nearly entire specimens bearing low prism-faces and showing the characteristic expansion of the frond near the base.

Chemung group. *Friendship, New York.*

PRISMODICTYA PARALLELA, Hall (sp.).

Page 82.

(See Plates XIX and XXI.)

Figure 9. A part of a very long specimen showing little increase in diameter throughout its length.

Chemung group. *Hinsdale, New York.*

DICTYOSPONGIDÆ.

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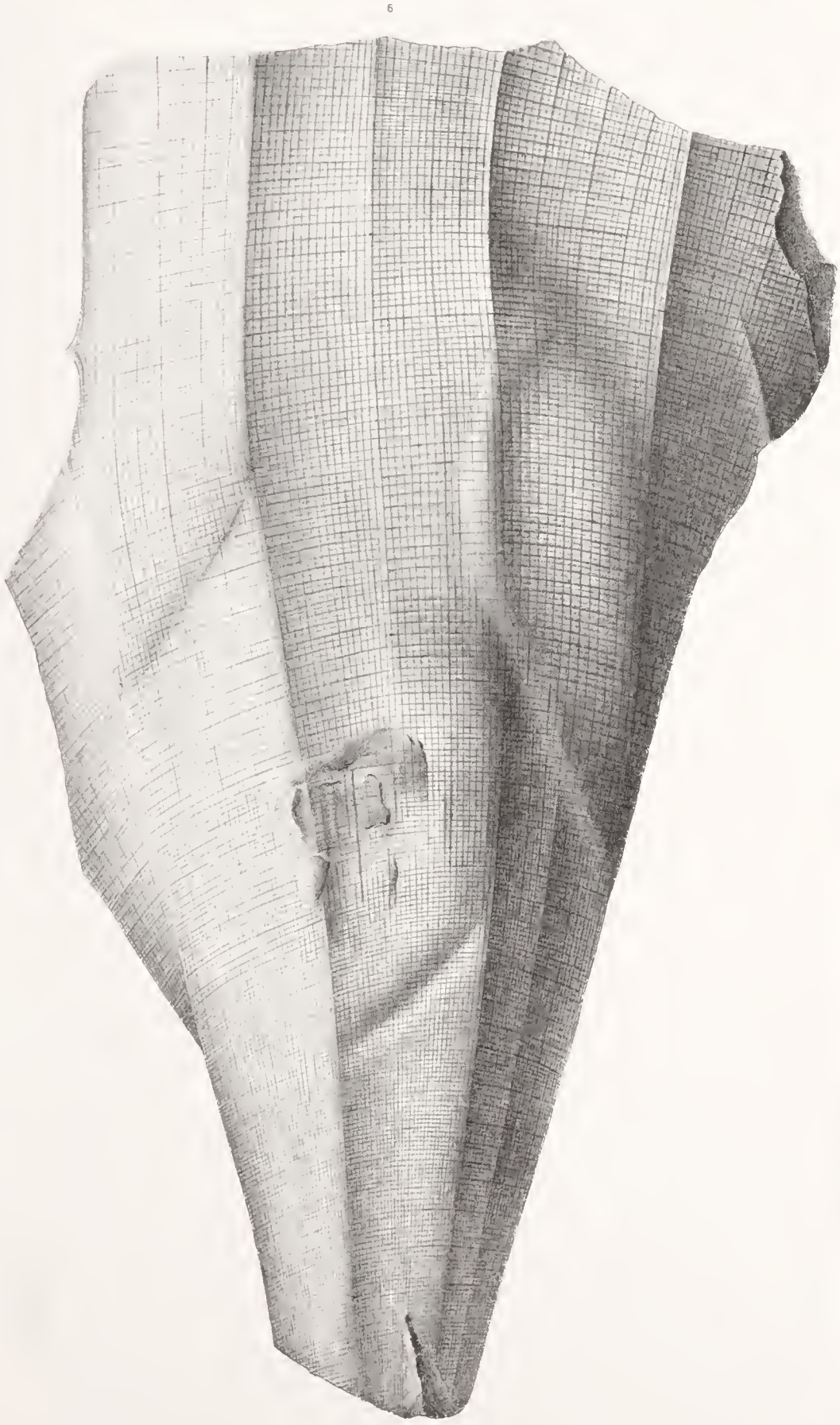
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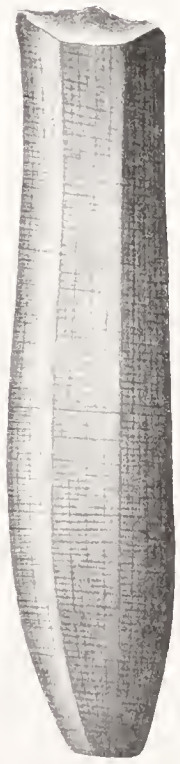
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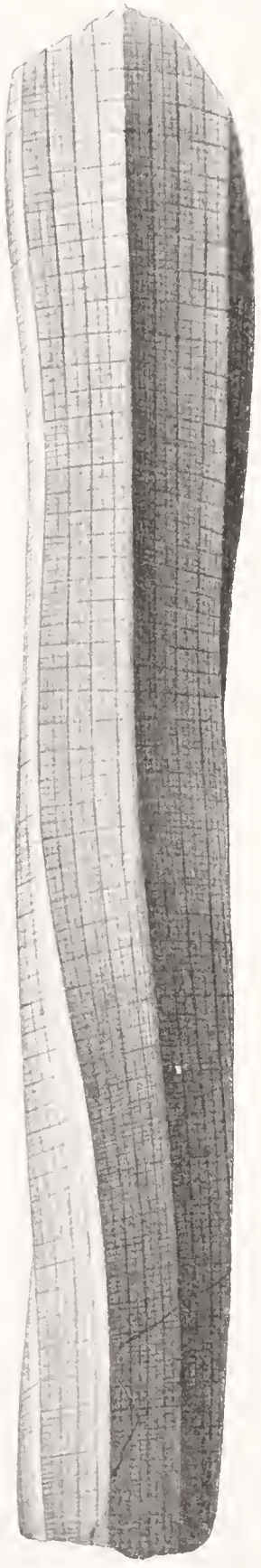
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PLATE XXXVI.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS VARIABILE, sp. nov.

Page 108.

(See Plate XXXVII.)

Figure 1. The apical portion of a specimen with coarse, strong, subequal meshes. There is no indication of nodes upon the surface of the cast, except near the broken end, but the matrix shows the presence of nodal tufts in this region.
Lower Chemung. *Deyo basin, Naples, New York.*

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XLI, XLII, LV.)

PRISMODICTYA AMICITLE, sp. nov.

Page 87.

Figures 2, 3. Two specimens which show the elongate and slender form of the species, with the abrupt and gradually declining expansion of the sponge above the base.

Figure 4. This specimen, found in association with numerous individuals of this species, shows a spiral twisting of the frond, resulting from abnormal growth.
Chemung group. *Friendship, New York.*

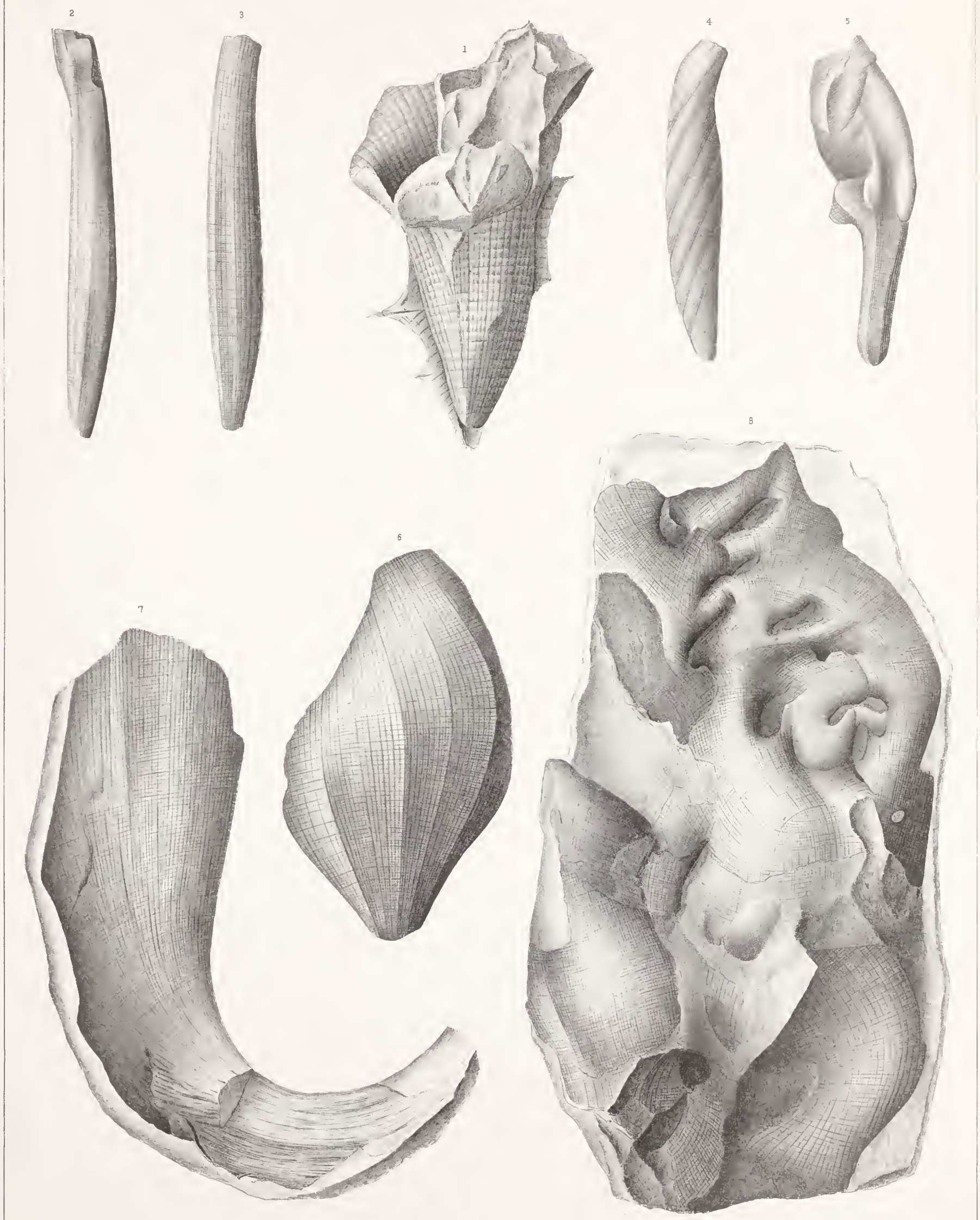
PRISMODICTYA CITHARA, sp. nov.

Page 90.

(See Plate XXXV.)

Figure 5. A large and somewhat distorted specimen of this species in which the nodes upon the expanded portion are rendered conspicuous by compression of the prism-faces.
Chemung group. *Scio, New York.*

DICTYOSPONGIDÆ.



G.B. Simpson del.

Philip Ast lith

PRISMODICTYA sp. ?

Figure 6. A compressed, expanded and somewhat twisted frond whose specific relations have not been determined. It bears some relation to *P. ptionia* but differs therefrom in its less abrupt expansion and broader, shorter basal region.
Chemung group. *Scio, New York.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

Page 73.

(See Plates XIV, XV, XVI, XXVII.)

Figure 7. The basal end of a specimen, showing a portion of the long anchoring tuft.
Chemung group. *Ischua, New York.*

HALLODICTYA, gen. nov.

Page 140.

(See Plate XLI.)

HALLODICTYA SCIENSIS, sp. nov.

Page 140.

Figure 8. The original specimen, showing the expanded, irregular and nodose character of the sponge. The reticulation is, in itself, regularly constructed but conforms to the highly uneven surface. This specimen is a mould of the exterior surface and the depressions represented on the drawing indicate nodes of the outer surface.
Chemung group. *Scio, New York.*

PLATE XXXVII.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS RHOPALUM, sp. nov.

Page 107.

Figures 1, 2. Opposite sides of a very slender, somewhat malformed specimen with faint indications of nodes over the lower half of the surface. The mode of growth here exhibited and the general aspect of the sponge is quite distinct from that of *H. tuberosum*, in association with which this specimen was found.

Chemung group. *Brown hill colony, near Cohocton, New York.*

HYDNOCERAS PHYMATODES, sp. nov.

Page 104.

(See Plate VI.)

Figure 3. A small nearly entire specimen with five well defined horizontal rows of rather low nodes and two faintly developed additional rows, one at the base and one at the aperture.

Lower Chemung. *Italy, Yates county, New York.*

HYDNOCERAS VARIABILE, sp. nov.

Page 108.

(See Plate XXXVI.)

Figures 4, 6. Opposite sides of a specimen preserving the apertural portion of the sponge and showing the indistinct nodes and irregular form which characterize the species.

Figure 5. Another specimen showing similar characters and the coarse reticulation of the cast.

Lower Chemung. *Deyo basin, Naples, New York.*

DICTYOSPONGIDÆ.

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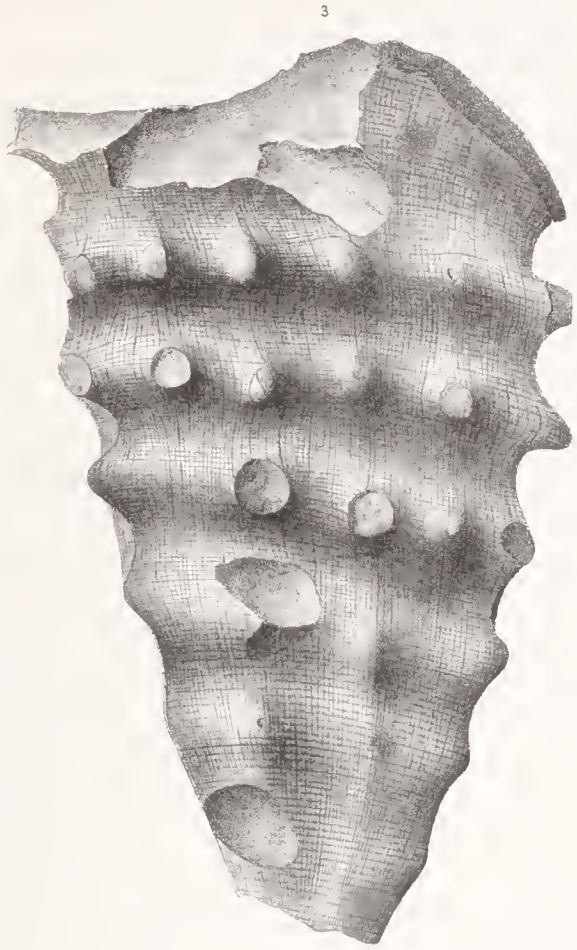

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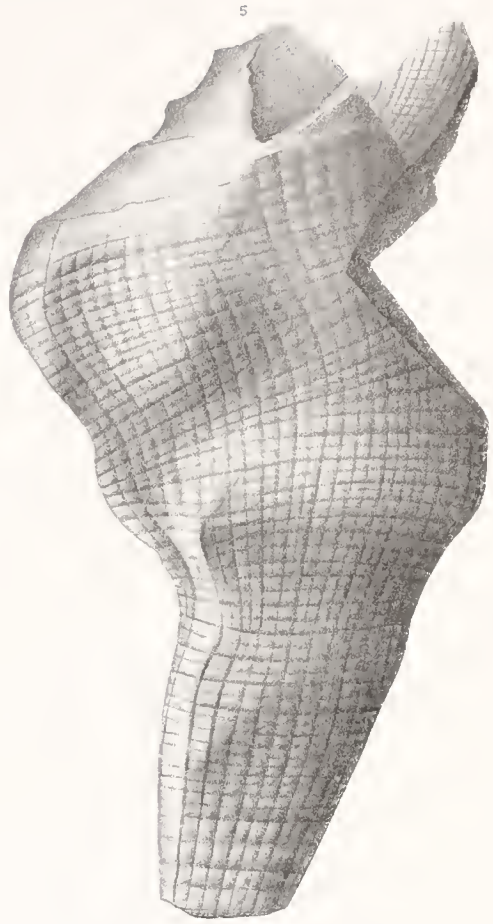

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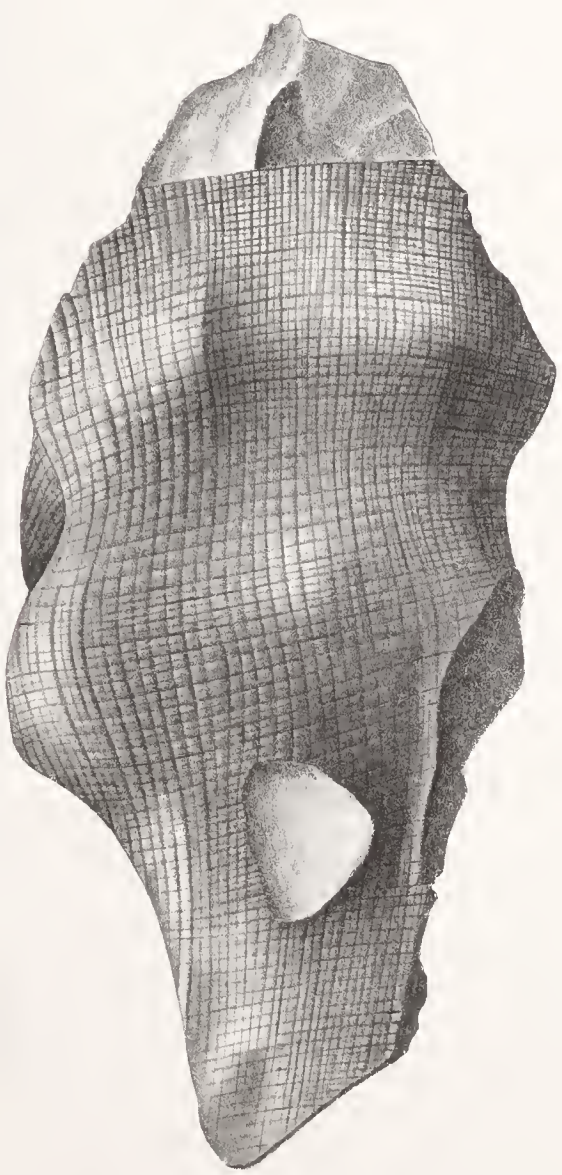

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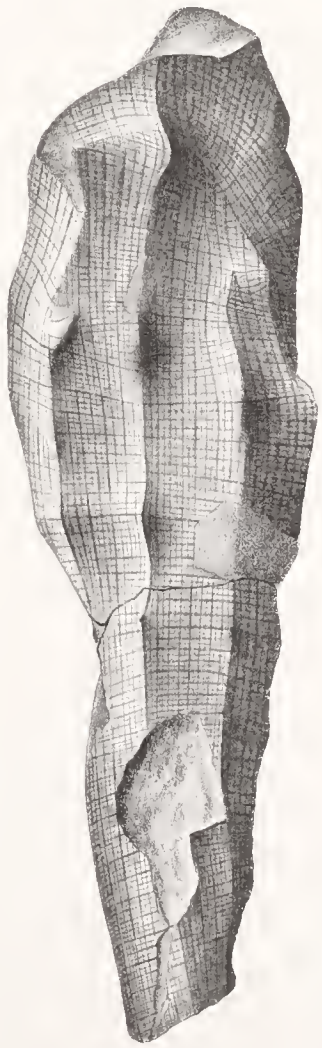

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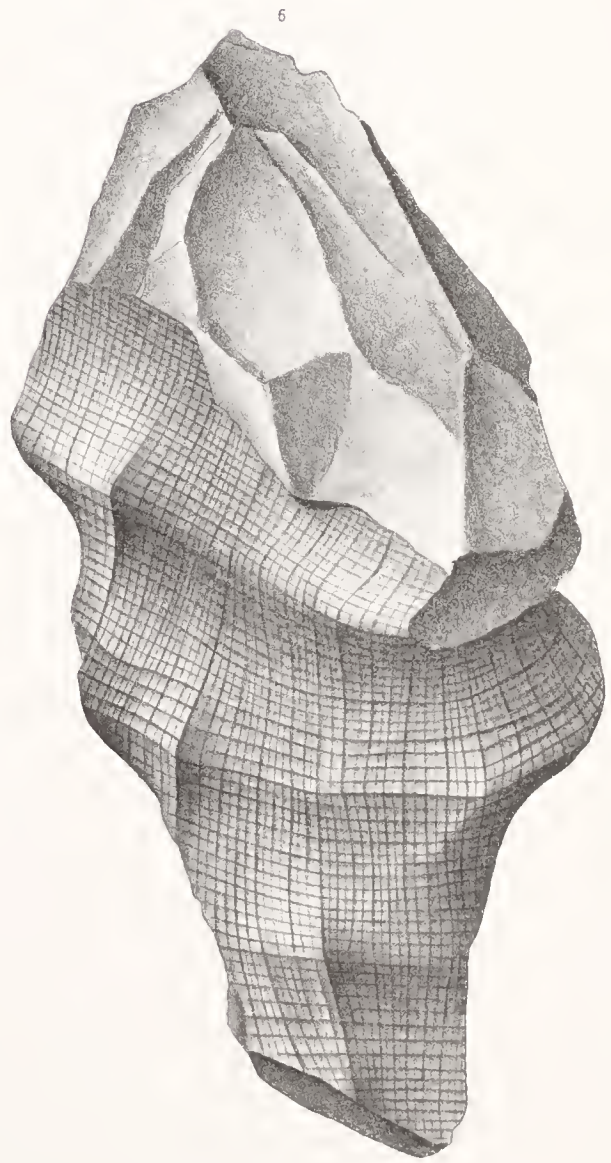

PLATE XXXVIII.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXIX, XLVI.)

HYDNOCERAS TUBEROSUM, Conrad.

Page 97.

(See Plates II, III, IV, V, VI, VII, VIII.)

Figures 1, 2. Opposite sides of a short compressed specimen of somewhat irregular growth and unusual in the number of nodes (eleven) in the second and third horizontal rows.

Lower Chemung. *Brown hill colony, near Cohocton, New York.*

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXVII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA QUASILLUM, sp. nov.

Page 131.

Figures 3, 4. Opposite sides of a specimen figured to illustrate the extreme difference in retention of the reticulum possible in the same specimen. In figure 3 the finer net-work is wholly obliterated and only the coarse primary meshes have left their impression on the sandstone cast. On the other side (figure 4) the primary bands are but obscurely visible while the minute ultimate meshes of the reticulum have left their impression on the thin shaly coating of the sandstone cast.

Chemung group. *Weston Mills, Cattaraugus county, New York.*

THYSANODICTYA TURRICULA, sp. nov.

Page 135.

Figure 5. A coarsely reticulate specimen lying in its matrix and showing the basal diaphragm with some of the long and slender lateral tufts. The species is somewhat variable in shape and, in this instance, is swollen about the aperture.

Figure 6. A specimen which is essentially entire and gently tapers from base to aperture. It retains the basal disc and portions of the lateral tufts.

Chemung group. *Ischua, New York.*

DICTYOSPONGIDÆ.

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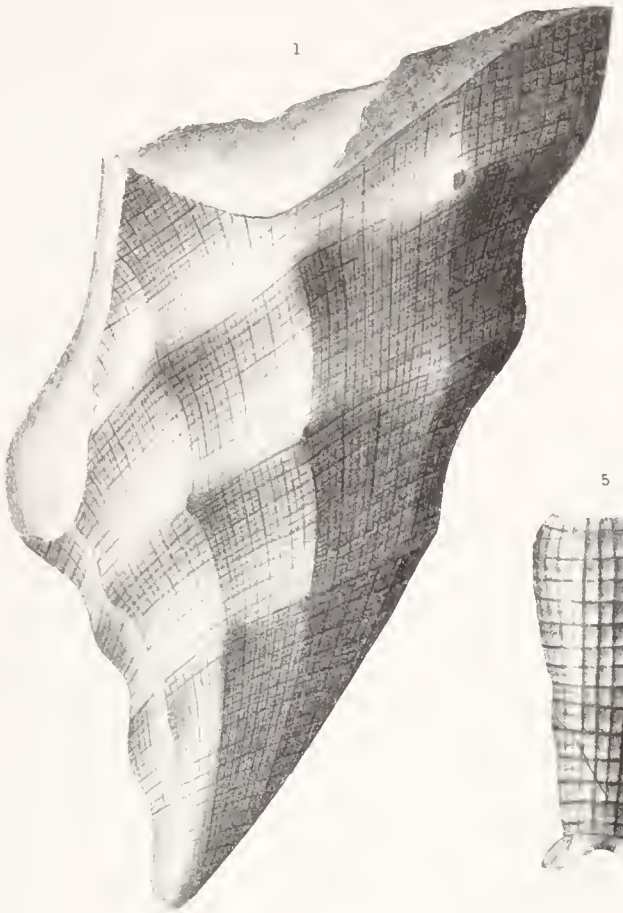

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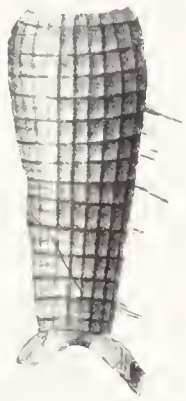

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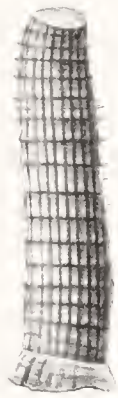

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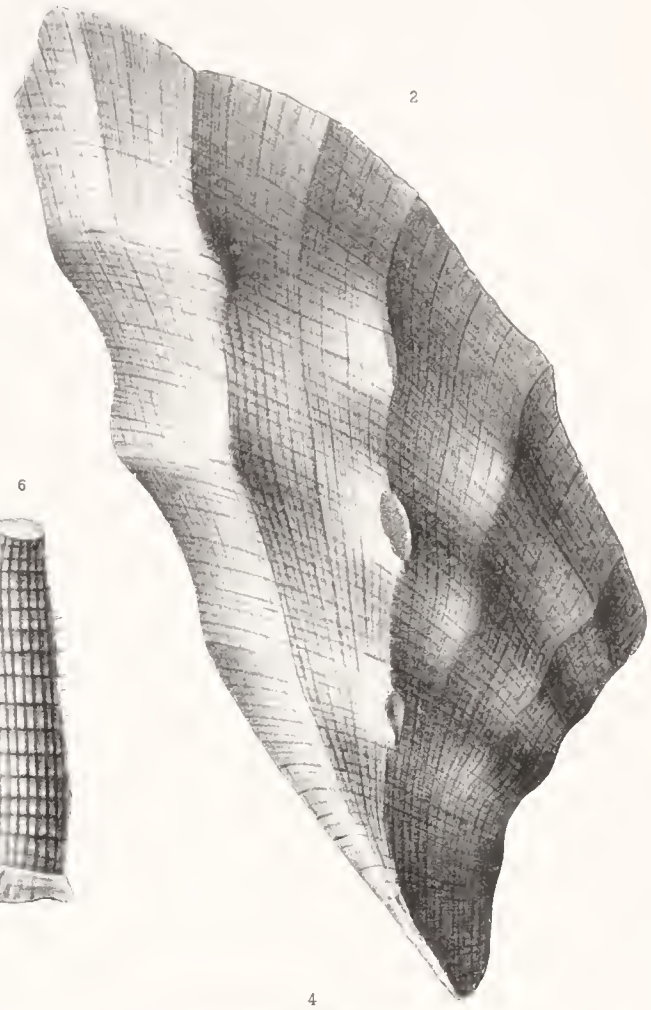

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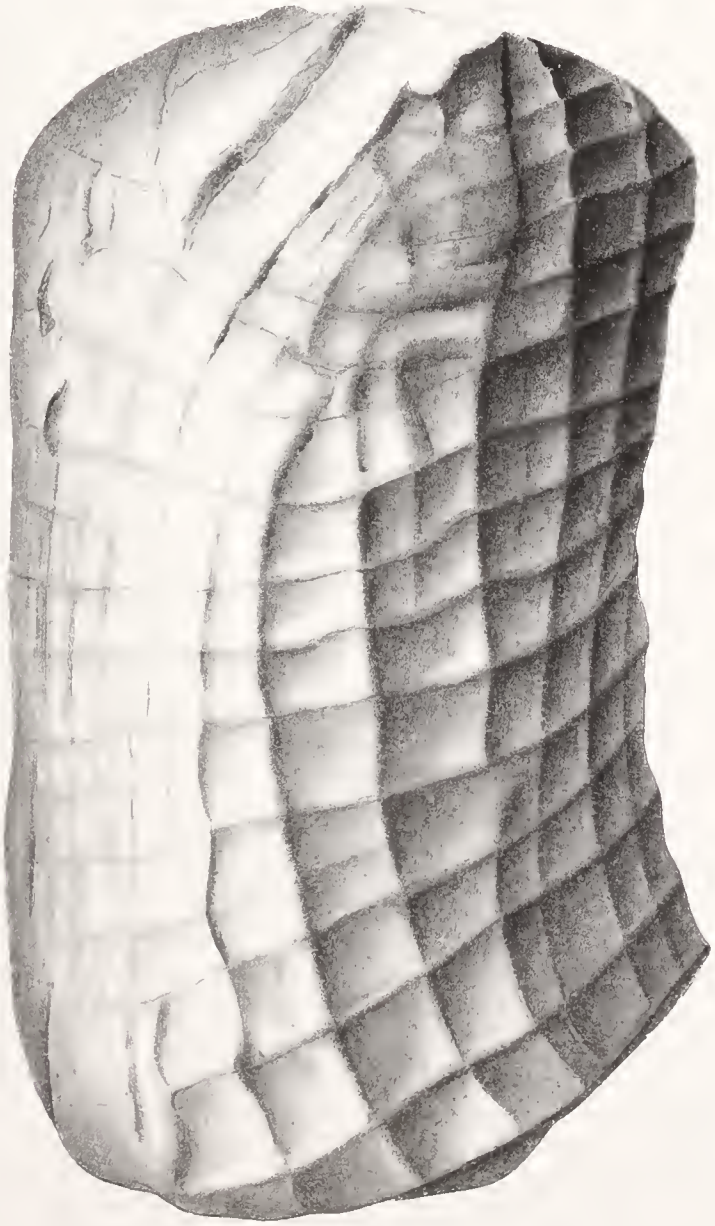

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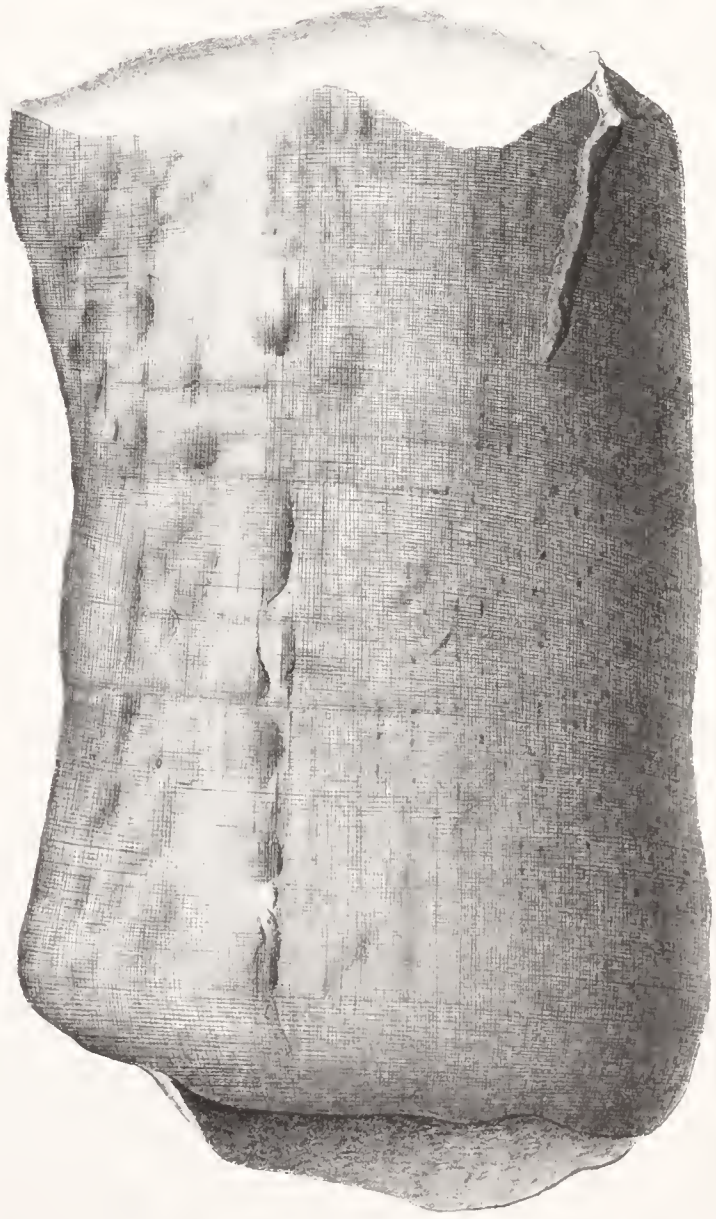

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA (?) BACTERIA, sp. nov.

Page 77.

Figures 7, 8. Two views of a supposed sponge with smooth surface, bearing very faint horizontal lines which are exaggerated in the drawings in order to make them visible. The fossil does not clearly show a structure which conclusively demonstrates it spongeous nature. Chemung group. *Steuben county (?), New York.*

PLATE XXXIX.

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XLVI.)

HYDNOCERAS MULTINODOSUM, sp. nov.

Page 106.

Figure 1. Fragment of a large individual bearing three horizontal rows of nodes and showing the unusual number of nodes in each row.
Chemung group. *Cotton hill, near Avoca, New York.*

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXVII, XXXVIII, XL, XLII, LIII.)

THYSANODICTYA HERMENIA, sp. nov.

Page 133.

(See Plates XXVII and XL.)

Figure 2. A large basal disc with its undulated periloph or peripheral expansion. The reticular net-work is sharply defined and it is seen that the two sets of reticular bands here intersecting are those which, passing upward over the vertical surface of the frond, produce both horizontal and vertical bands.
Chemung group. *Hinsdale, Cattaraugus county, New York.*

DICTYOSPONGIDÆ.

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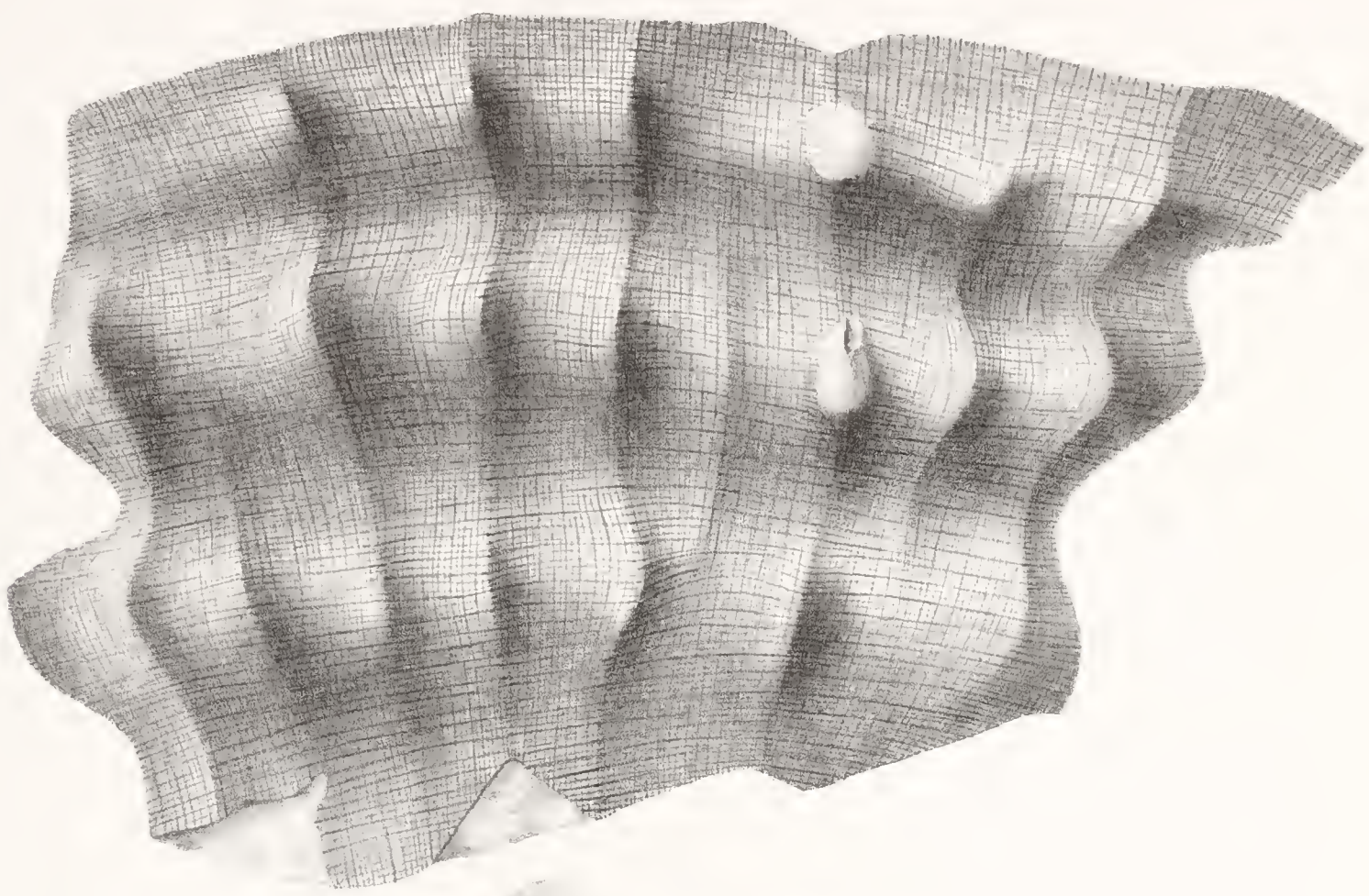

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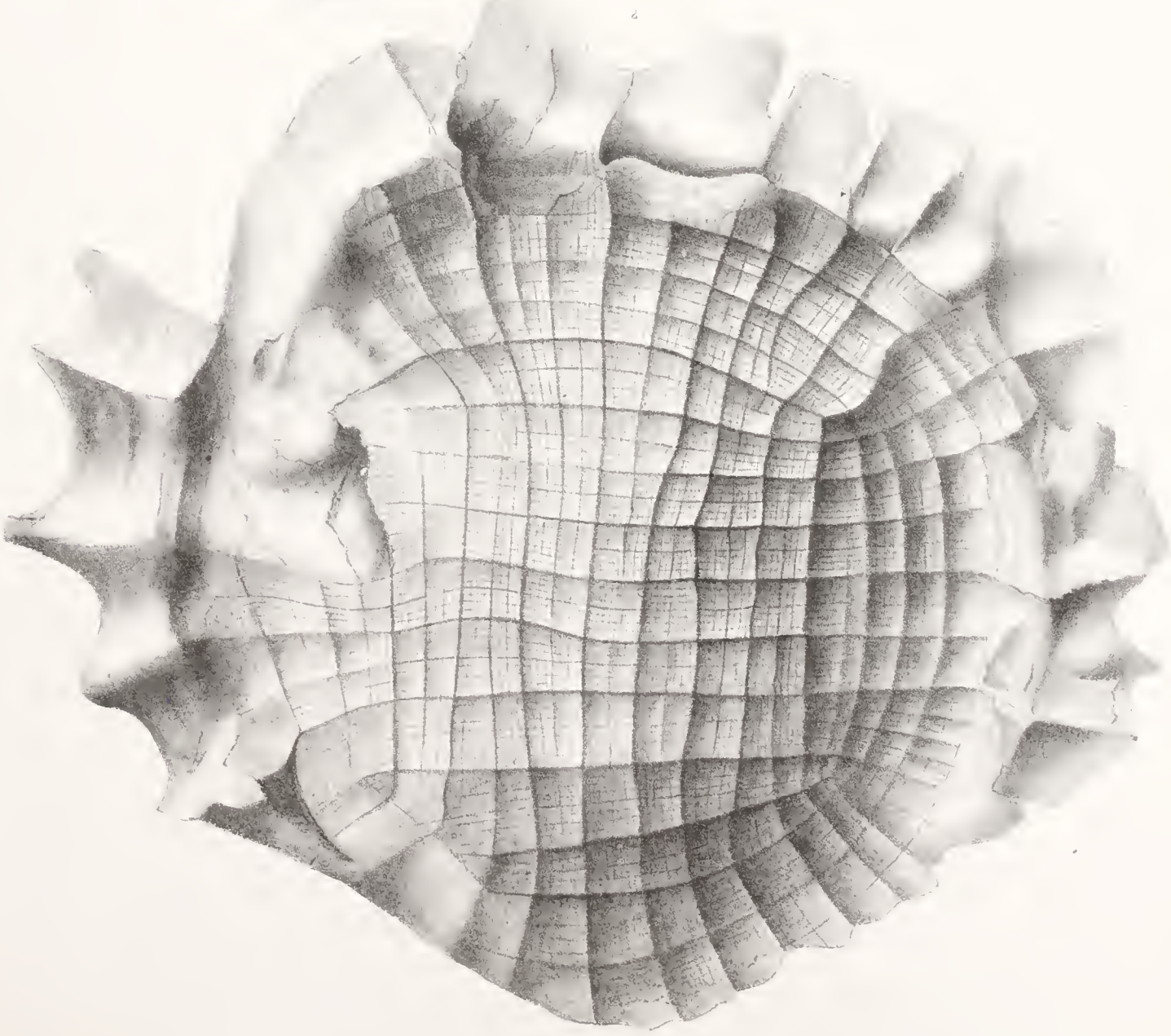


G.B Simpson del

PLATE XL.

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXVII, XXXVIII, XXXIX, XLII, LIII.)

THYSANODICTYA HERMENIA, sp. nov.

Page 133.

(See Plates XXVII and XXXIX.)

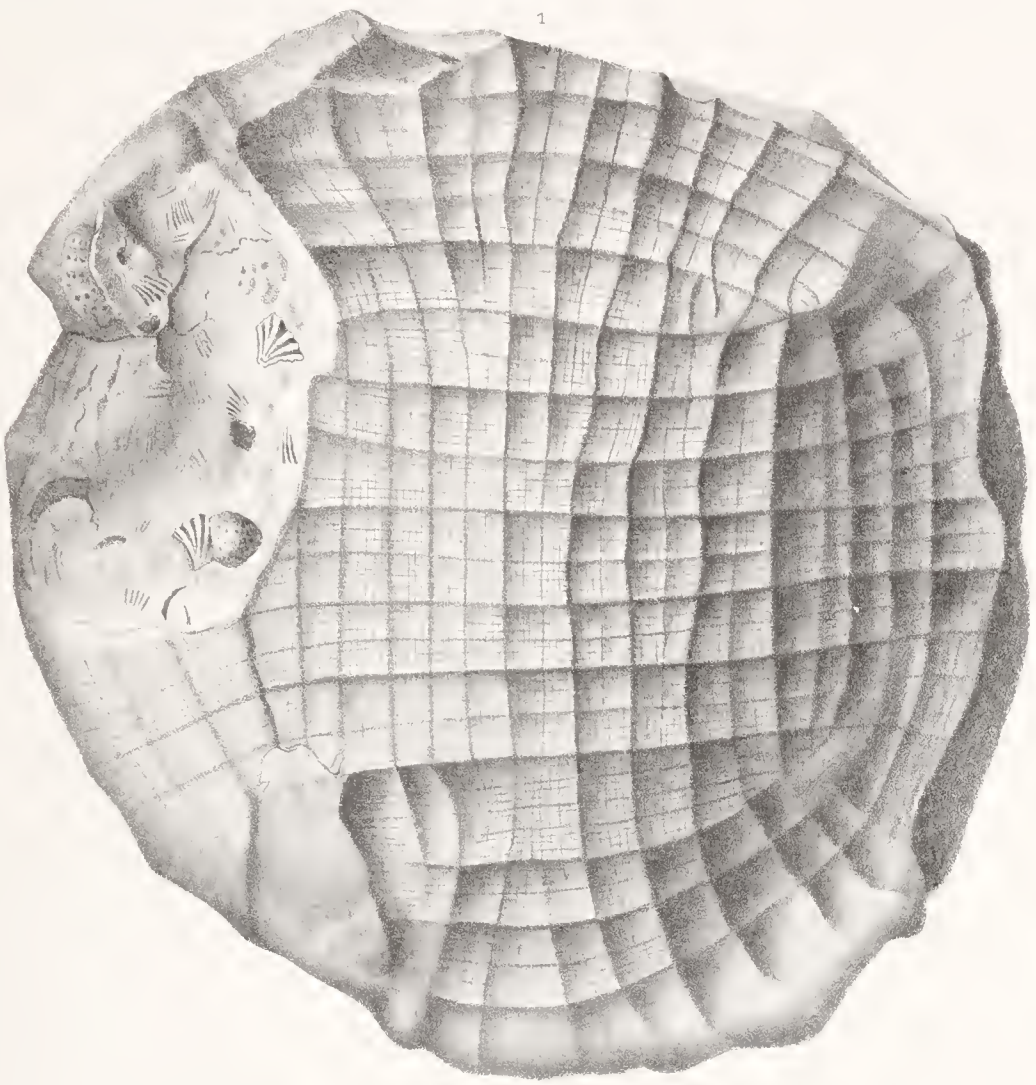
Figures 1, 2. Basal discs without the periloph but preserving more or less completely the coarser and finer reticulation.

Figure 3. Side view of a rather small specimen with the basal disc poorly retained. The sponge has been crushed toward the upper end and a part of its diameter with, doubtless, a considerable portion of the length has been lost.

Chemung group. *Hinsdale, Cattaraugus county, New York.*

DICTYOSPONGIDÆ.

1



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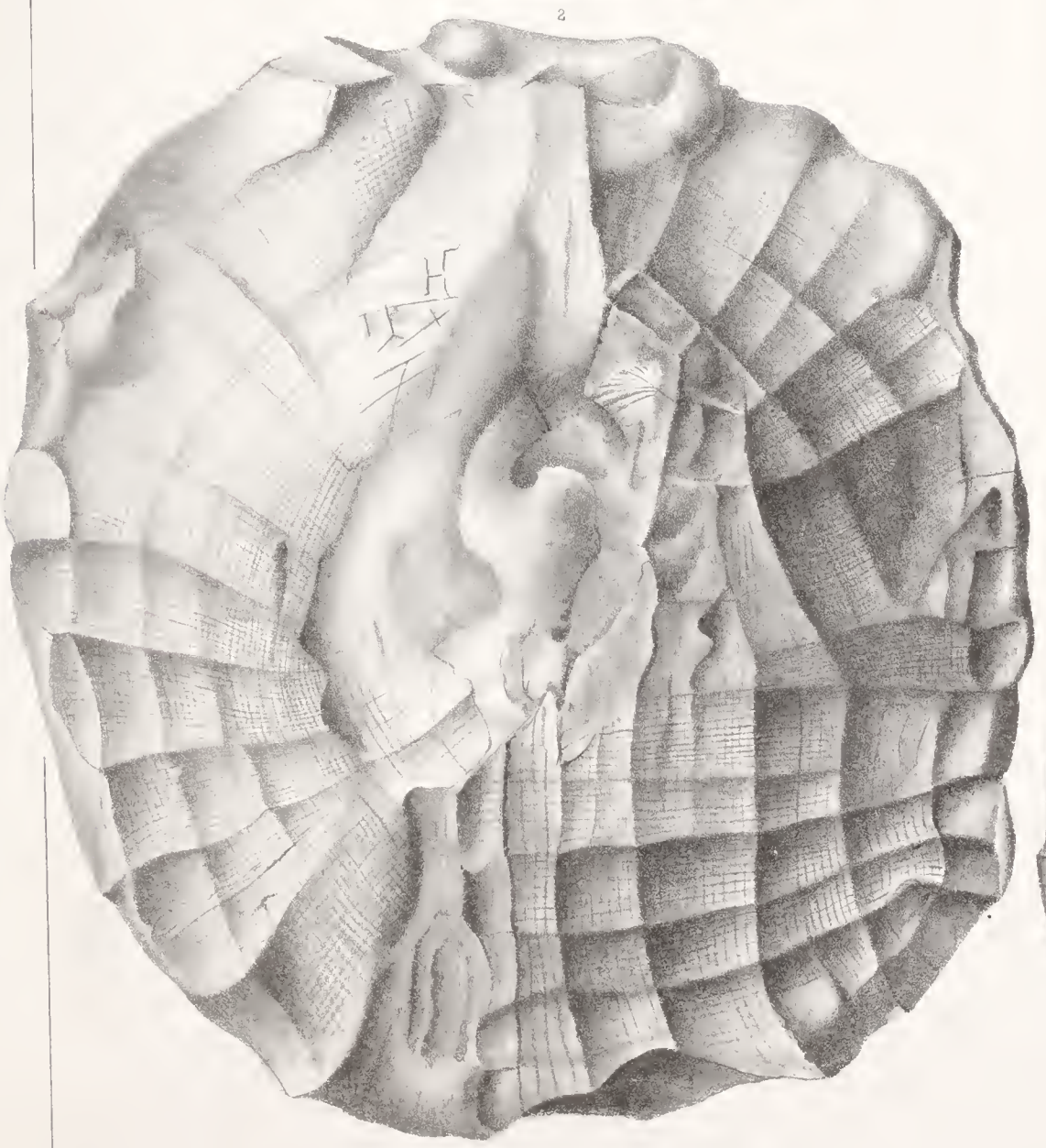

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G.B. Simpson del.

C. Fause, lith.

PLATE XLI.

CERATODICTYA, gen. nov.

Page 117.

(See Plates XXII, XLII, XLIII.)

CERATODICTYA CENTETA, sp. nov.

Page 120.

Figure 1. A very young individual.

Figure 2. A fragment of a large example.

Figures 3, 4, 5. Specimens of medium size, showing some irregularity in the size of, and intervals between the annulations.

Chemung group. *Ischua, New York.*

CERATODICTYA ZONATA, sp. nov.

Page 119.

Figure 6. The type-specimen, showing equidistant and broad annulations.

Chemung group. *Found loose at Erie, Pennsylvania.*

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLII, LV.)

PRISMODICTYA AULOPHIA, sp. nov.

Page 88.

(See Plates XX and XXXIV.)

Figure 7. Fragment of a large specimen; showing the concave prism-faces and finely preserved net-work.

Chemung group. *Wellsville, New York.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA (?) MARCELLIA, Clarke (sp.).

Page 65.

Figure 8. A portion of the suface of a piece of bituminous shale covered with pyritized spicules of this species.

Figure 9. An enlargement from the same, showing the cruciform spicules and the broad ligulate spicules whose position in the skeleton is not yet understood.

Marcellus shale. *In the Livonia salt shaft, Livonia, New York.*

DICTYOSPONGIDÆ.

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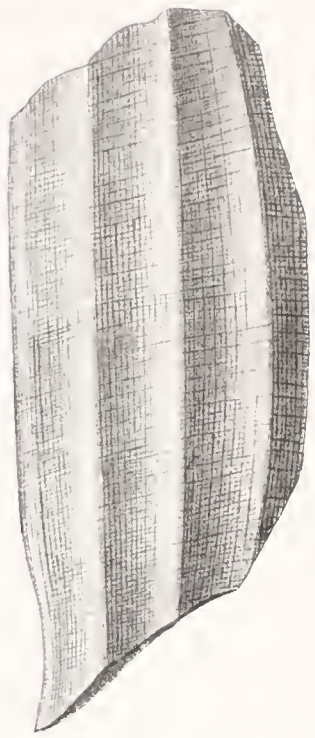
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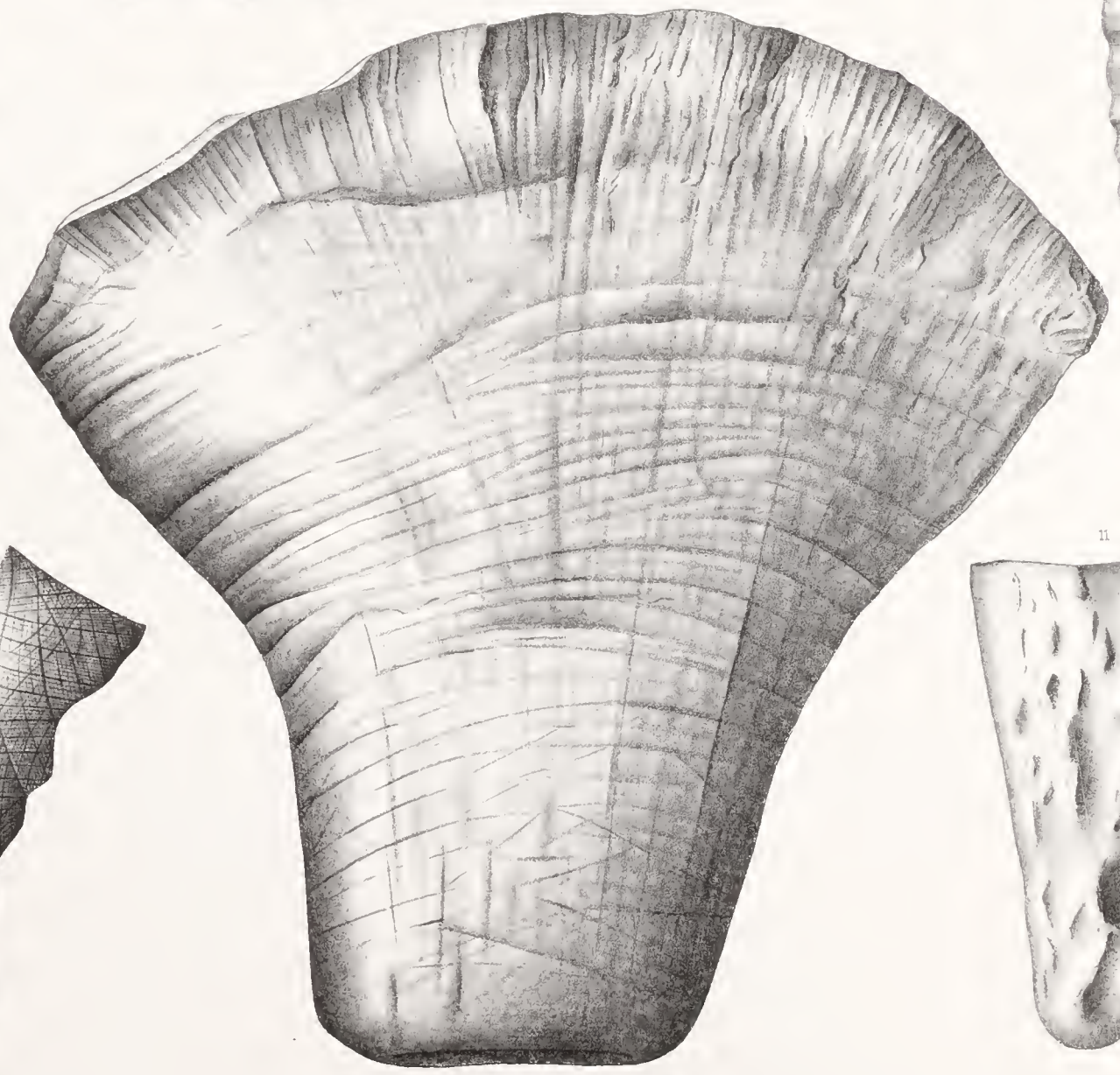
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G.B Simpson del

Philip Ast lith

ARYSTIDICTYA, gen. nov.

Page 136.

(See Plate XLII.)

ARYSTIDICTYA ELEGANS, sp. nov.

Page 136.

(See Plate XLII.)

Figure 10. One side of the typical specimen which is preserved from the base or basal disc to the aperture. The drawing has intensified the wrinkles of the reticulum resulting from a slight foreshortening, and fails to give with proper force the regularly reticulating bands which are clearly apparent especially over the lower part of the sponge. The marginal radiating channels about the edge of the vase are well shown.

Lower Chemung group. *Cotton hill, near Avoca, New York.*

ARYSTIDICTYA NODIFERA, sp. nov.

Page 137.

Figure 11. The specimen described; a portion of a vase-shaped sponge like *A. elegans*, having the surface covered with elongate, irregularly disposed nodes.

Lower Chemung group. *Cotton hill, near Avoca, New York.*

HALLODICTYA, gen. nov.

Page 140.

(See Plate XXXVI.)

HALLODICTYA COTTONIANA, sp. nov.

Page 142.

Figure 12. A fragment of a frond having a sharply, somewhat irregularly reticulate surface, free of nodes.

Lower Chemung group. *Cotton hill, near Avoca, New York.*

PLATE XLII.

CERATODICTYA, gen. nov.

Page 117.

(See Plates XXII, XLI, XLIII.)

CERATODICTYA CARPENTERIANA, sp. nov.

Page 117.

(See Plate XLIII.)

Figure 1. A finely preserved specimen of a part of the sponge, having an apparently normal curvature, and showing the character of the reticulum and the duplicate annulations.
Chemung group. *Near Ischua, New York.*

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, LV.)

PRISMODICTYA TELUM, Hall (sp.).

Page 80.

(See Plates XVII and XXXV.)

Figure 2. A small cigar-shaped individual showing a twisted or spiral mode of growth.
Chemung group. *Wellsville, New York.*

PRISMODICTYA CERCIDEA, sp. nov.

Page 89.

(See Plate XX.)

Figure 3. A flattened but entire example, showing the expansion of the sponge above the middle and the low nodes on the prism-angles.
Chemung group. *Wellsville, New York.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SIRÆA, sp. nov.

Page 75.

Figures 4, 5. Two individuals showing the size and general form of the species, one of them (figure 4) retaining the long tuft of basal spicules.
Lower Chemung group. *Cotton hill, near Avoca, New York.*

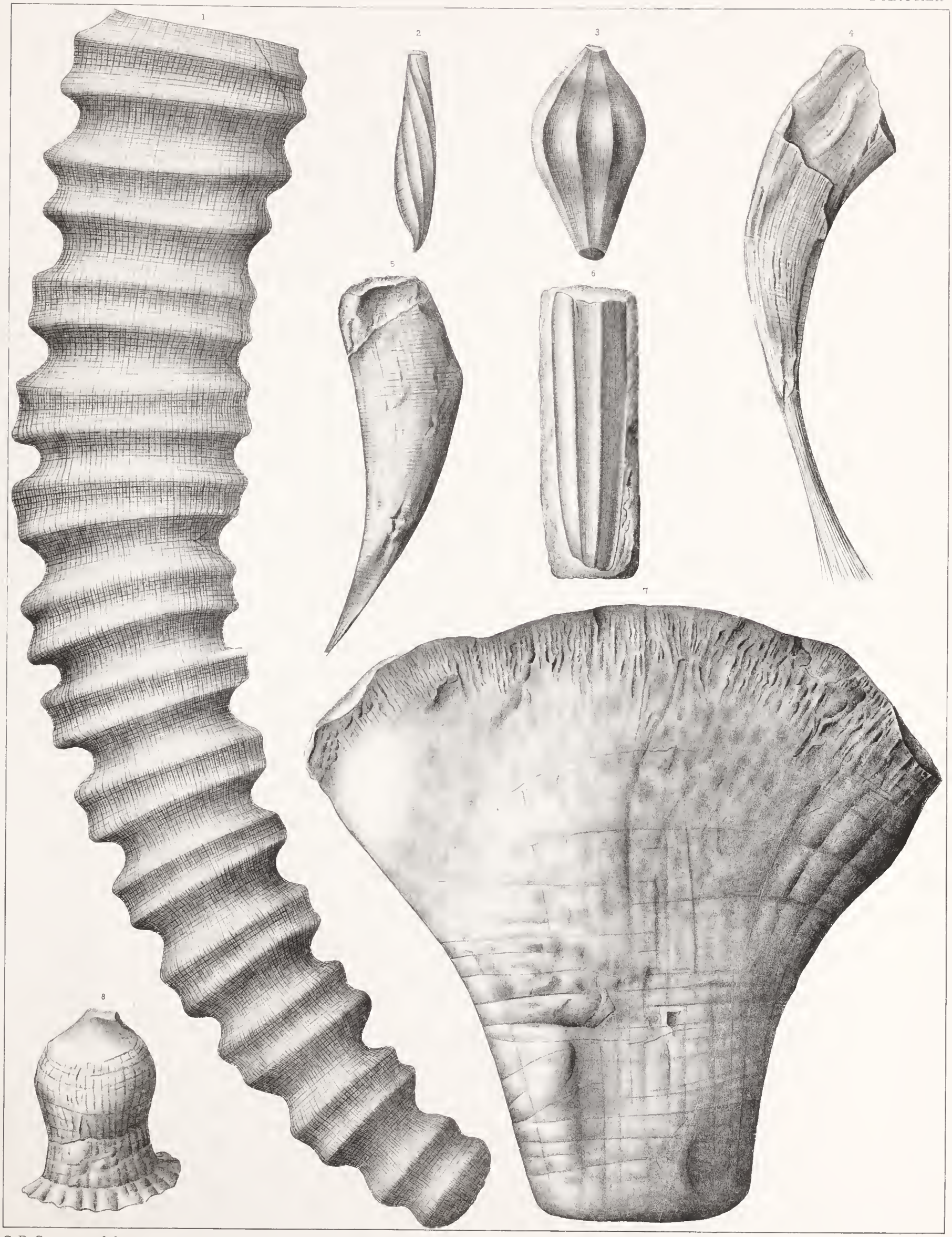
PRISMODICTYA cf. PRISMATICA, Hall.

Figure 6. Part of a cup which may prove to belong to this species.
Lower Chemung group. *Italy, Yates county, New York.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate XLII



G.B Simpson del

Philip Ast lith

ARYSTIDICTYA, gen. nov.

Page 136.

(See Plate XLI.)

ARYSTIDICTYA ELEGANS, sp. nov.

Page 136.

(See Plate XLI.)

Figure 7. The other side of the specimen figured on Plate xli, showing the regular reticulation over the lower part of the cast and the radiating peripheral channels.

Lower Chemung group. *Cotton hill, near Avoca, New York.*

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA SCYPHINA, sp. nov.

Page 132.

Figure 8. The typical specimen, showing the undulated basal periloph or fringe of the diaphragm.

Chemung group. *Olean, New York.*

PLATE XLIII.

CERATODICTYA, gen. nov.

Page 117.

(See Plates XXII, XLI, XLII.)

CERATODICTYA CARPENTERIANA, sp. nov.

Page 117.

(See Plate XLII.)

Figure 1. A large fragment of this species, complete at neither extremity. This drawing has been made from several pieces of the same individual and as these did not perfectly fit, the figure does not represent the entire length of the fragment. The specimen shows the very gradual expansion of the sponge, indicating that it must have attained great length at full growth.

Figure 2. Another fragment preserving the apical portion entire and showing the gradual change with growth in the aspect of the annulations.
Chemung group. *Near Ischua, New York.*

Figure 3. A very imperfect fragment from near the aperture of a full grown specimen. This specimen indicates the great length which the species must have attained and shows the ultimate modification in the form of the annulations which are here brought so close together that their duplicate character is obscured.
Chemung group. *Randolph, New York.*

PLATE XLIV.

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLVI, LV, LVI LXI.)

DICTYOSPONGIA ALMONDENSIS, sp. nov.

Page 76.

Figure 1. A large fragment representing the upper part of a frond of great size. Fragments of this character abound at the locality from which this was obtained, but so large and fragile was the sponge that no entire individual has been obtained and but very few specimens which afford a clew to the original form of the species. Elsewhere is given a drawing of the apical portion of one of these sponges which shows that it was doubtless a DICTYOSPONGIA.

Chemung group. *In a bed of grey sandstone, at Almond, New York.*

DICTYOSPONGIDÆ.

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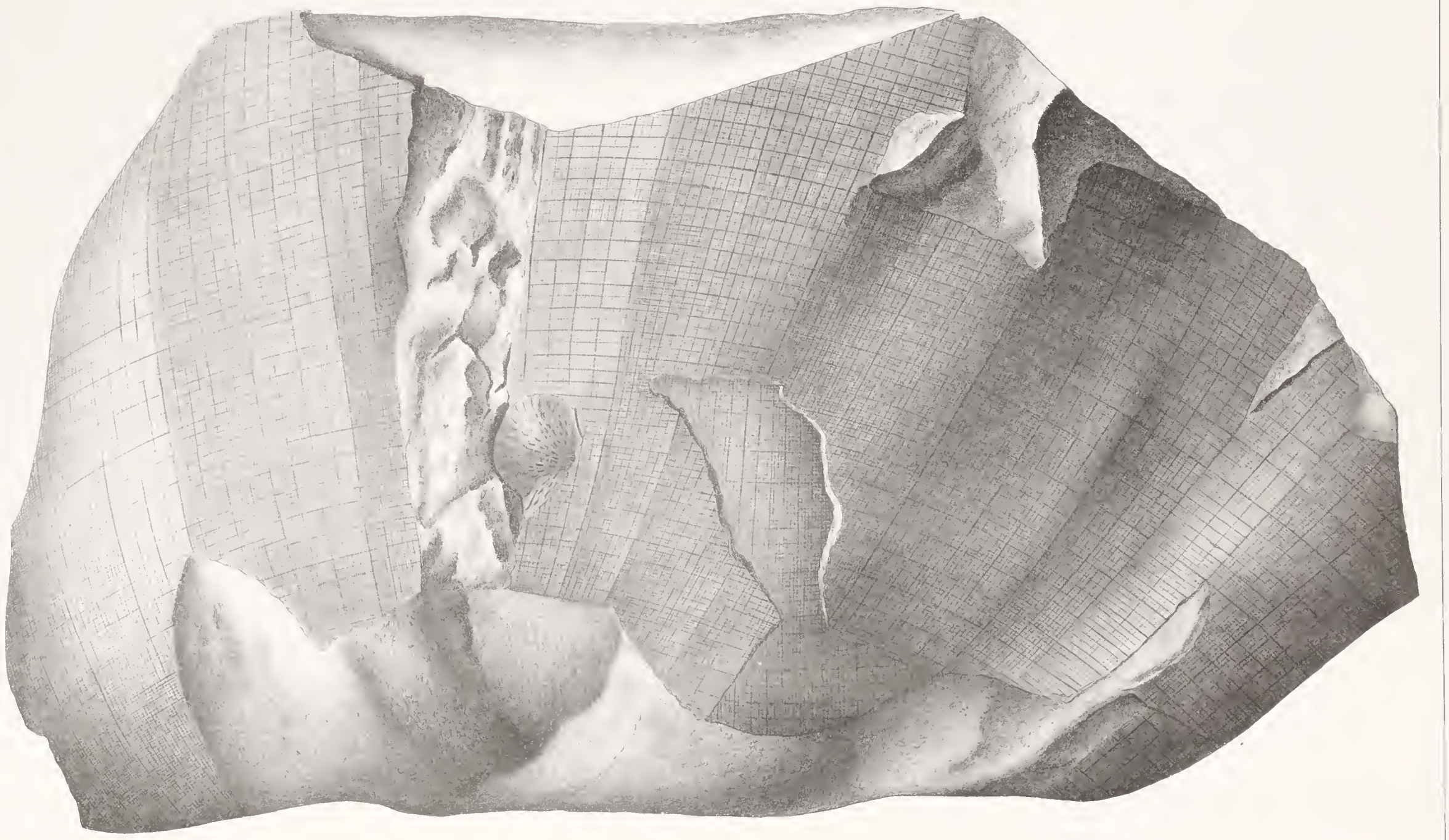

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PLATE XLV.

HYPHANTÆNIA, Vanuxem (*emend.*).

Page 137.

(See Plates XXVIII and XXIX.)

HYPHANTÆNIA CHEMUNGENSIS, Vanuxem.

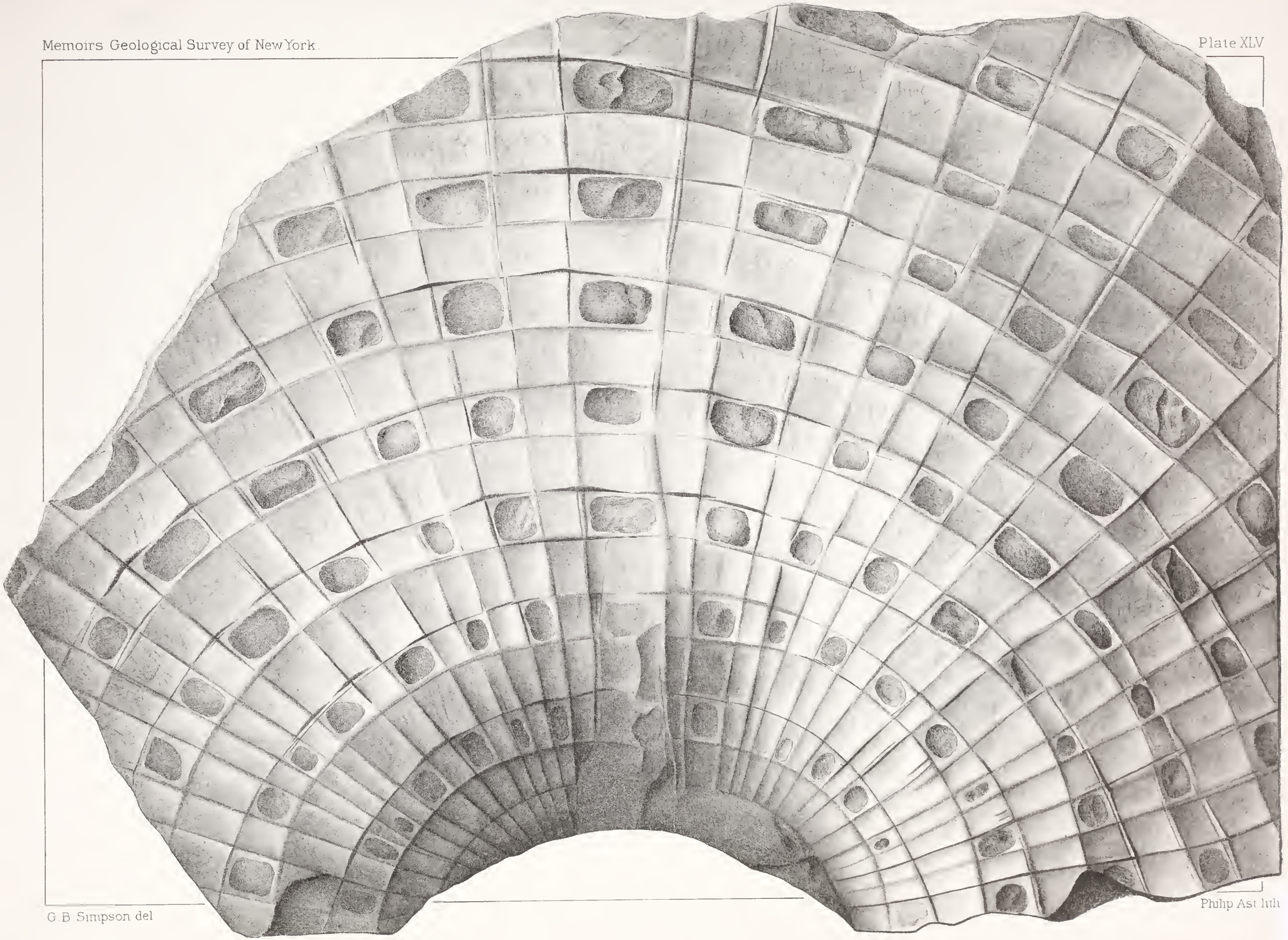
Page 139.

(See Plates XXVIII and XXIX.)

Figure 1. Fragment of the largest individual observed, slightly fractured near the middle. This specimen differs from those elsewhere figured in having the apertures left by the intersection of the ligulate bands circumscribed by an encroachment of the spicular tissue. The diameter of this specimen when entire was not less than two feet. Chemung group. *Union township, Broome county, New York.*

Memoirs Geological Survey of New York.

Plate XLV



G.B. Simpson del

Philip Ast lith

PLATE XLVI.

Species from the Psammites du Condroz, submitted by Professor CHARLES BARROIS, *of Lille, France.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, LV, LVI, LXI.)

DICTYOSPONGIA MORINI, Barrois (sp.).

Page 147.

Figures 1, 2. Views of the original specimen showing the smooth, regularly expanding cup.

Psammites du Condroz. *Jeumont, France.*

HYDNOCERAS, Conrad.

Page 95.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX.)

HYDNOCERAS BARROISI, nom. nov.

Page 147.

Figures 3, 4. The original specimen of *Dictyophyton tuberosum*, Barrois. This is a curved, strongly constricted cup, with moderately strong nodes upon the sharply developed prism-angles.

Psammites du Condroz. *Jeumont, France.*

HYDNOCERAS JEUMONTENSE, sp. nov.

Page 148.

Figure 5. A specimen with three horizontal rows of nodes and showing very gradual expansion of the cup.

Figure 6. Another fragment of the same species showing some variation in the number of nodes in each horizontal row. An additional piece of this specimen increases its length by about 60 mm. and has traces of two rows of nodes.

Psammites du Condroz. *Jeumont, France.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate XLVI

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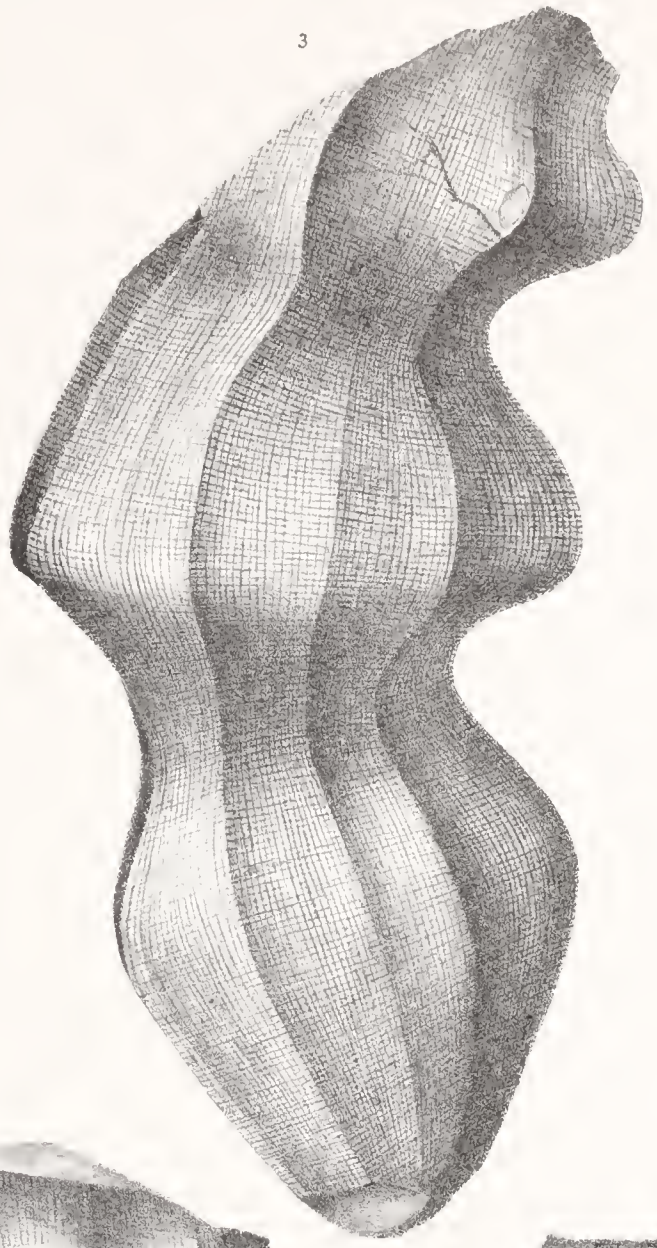
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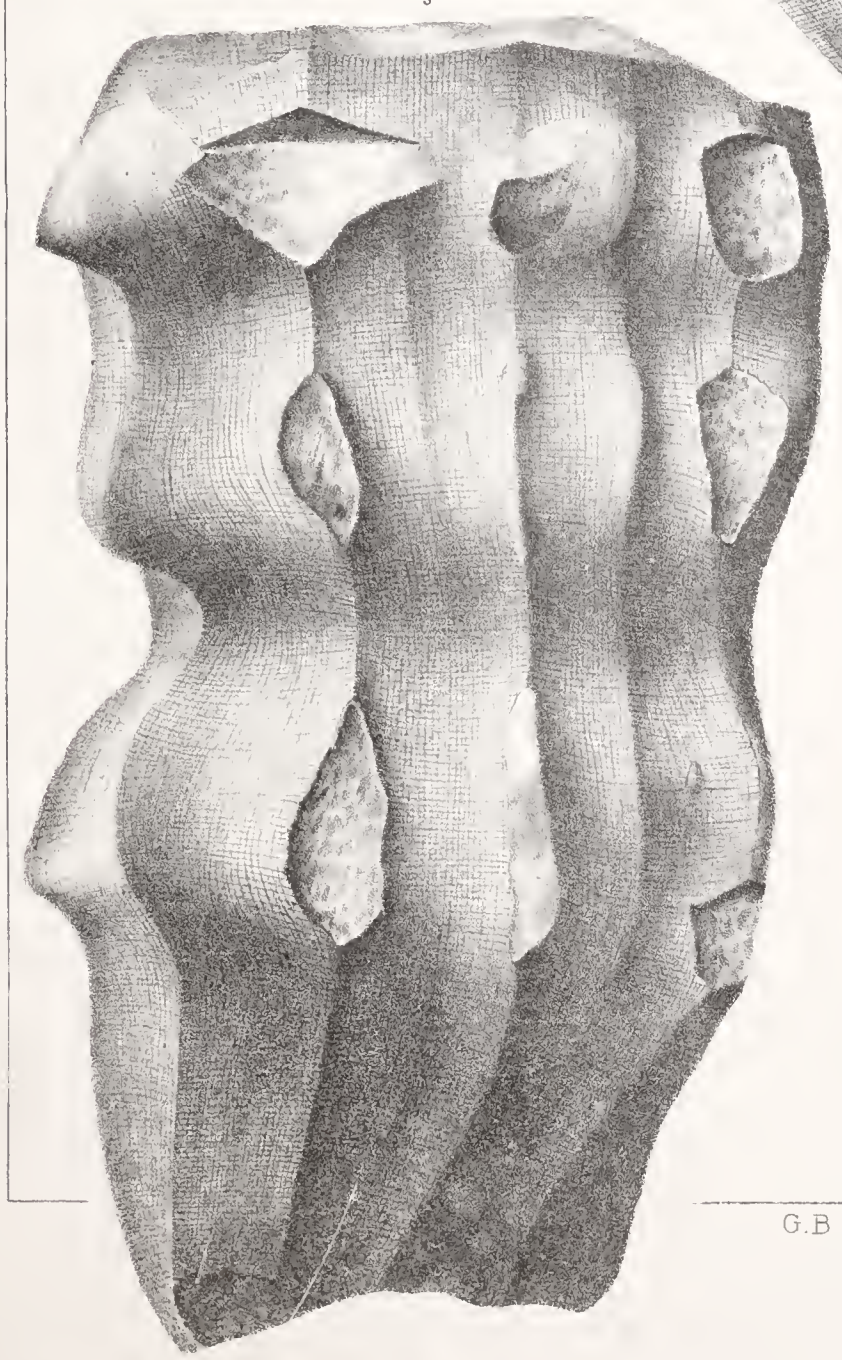
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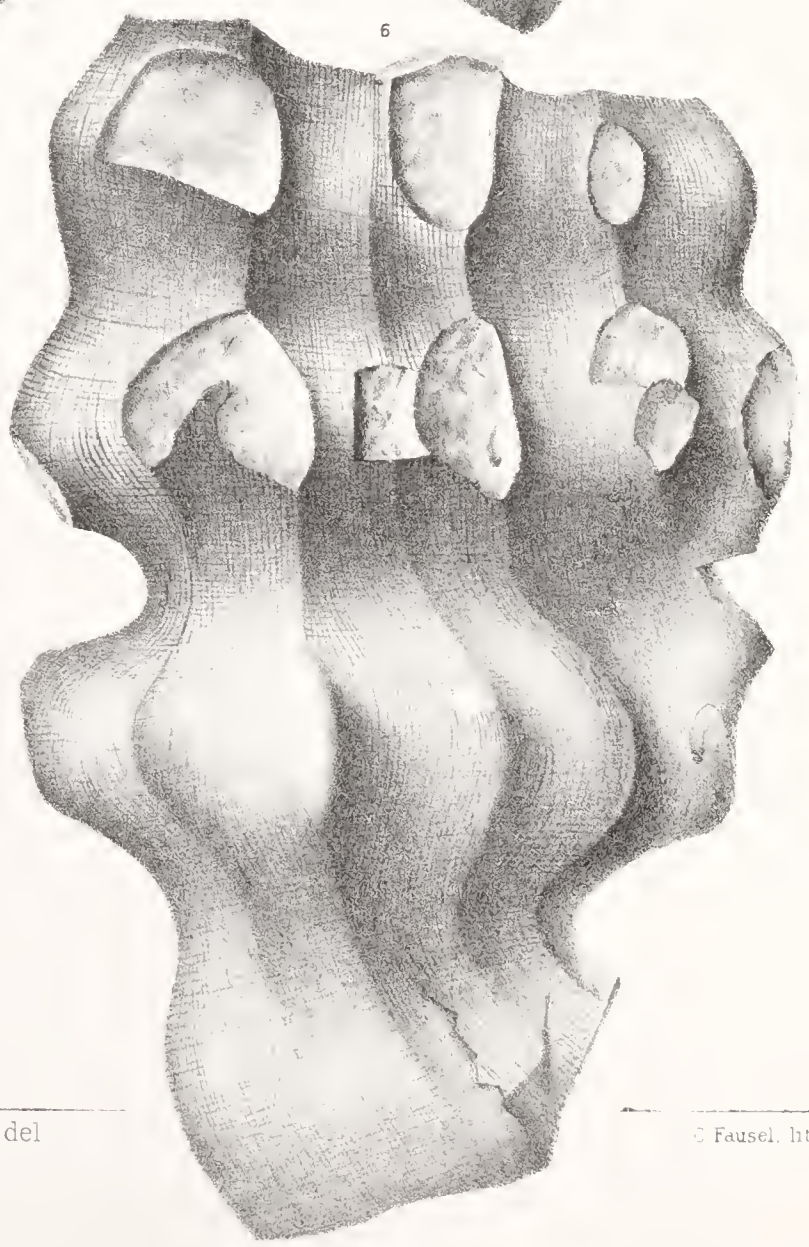
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C Fausel, lith

PLATE XLVII.

Species from the Psammites du Condroz, submitted by Professor CHARLES BARROIS, *of Lille, France.*

RHABDOSISPONGIA, gen. nov.

Page 116.

(See Plate XVI.)

RHABDOSISPONGIA CONDROZIANA, sp. nov.

Page 149.

Figures 1, 2. Opposite sides of the original specimen showing its strong, unequal annulations, producing a highly irregular form, and also the sharply developed prism-faces.

Psammites du Condroz. *Jeumont, France.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate XLVII

G.B Simpson del

C Fausel lith

PLATE XLVIII.

CALATHOSPONGIA, gen. nov.

Page 155.

(See Plates XLIX, L, LI, LII, LVI, LVII, LX, LXVIII.)

CALATHOSPONGIA REDFIELDI, Hall (sp.).

Page 155.

(See Plate XLIX.)

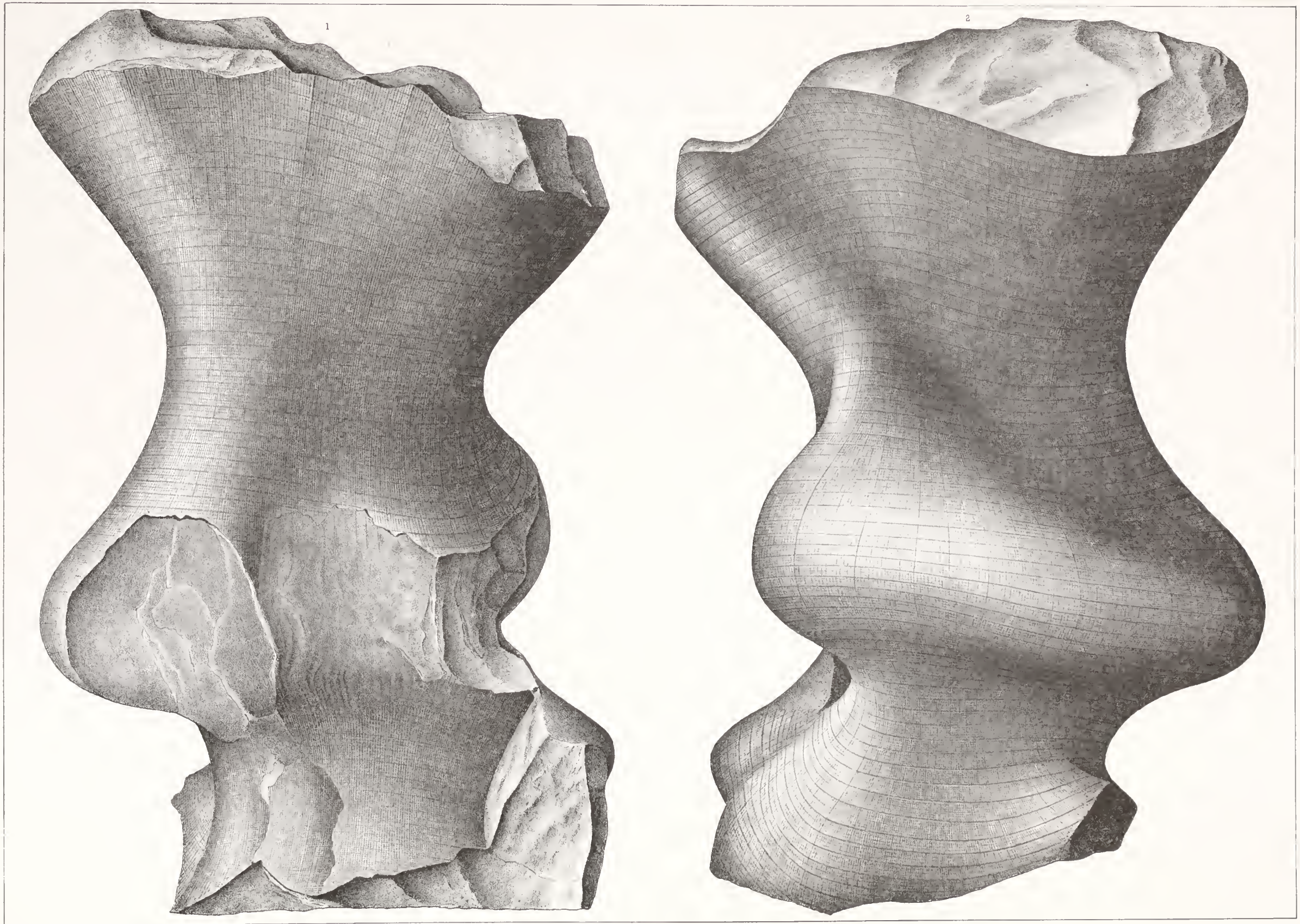
Figures 1, 2. Opposite sides of a fine, large, nearly entire sponge, with the aperture complete on one side. The median swelling of this cup seems to be due to distortion from vertical compression, and the base, though not actually retained was probably not greatly different from the present condition of the lower extremity. The specimen shows the characteristic surface features with great clearness, and over the apertural region as well as upon the swollen portion of the cup in fig. 2 may be seen obscure traces of the prismatic faces.

Waverly group. *Akron, Ohio.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate XLVIII



G.B Simpson del

Philip Ast lith

PLATE XLIX.

CALATHOSPONGIA, gen. nov.

Page 155.

(See Plates XLVIII, L, LI, LII, LVI, LVII, LX, LXVIII.)

CALATHOSPONGIA REDFIELDI, Hall (sp.).

Page 155.

(See Plate XLVIII.)

Figure 1. A fragment of a small specimen
Waverly group. *Richfield, Ohio.*

Figures 2, 3. The opposite sides of a specimen which is virtually entire, the apertural portion having been distorted by the vertical compression and rupture of the reticulum. The surface of this specimen has been somewhat abraded on the side shown in fig. 2, and the primary transverse bands of the reticulum are not as clearly displayed as in the example represented on the preceding plate. In fig. 3, the finer superficial net-work is predominant.

Figure 4. An enlargment of the surface from the same specimen, taken from near the top of the side shown in fig. 3. These figures are from the type-specimen of the species.
Waverly group. *Harrisville, Ohio.*

CLATHROSPONGIA, Hall.

Page 121.

(See Plates XIV, XV, XVIII, XXI, XXV, XLIX, L.)

CLATHROSPONGIA ABACUS, Hall.

Page 153.

Figure 5. A nearly complete individual which shows the obconical form of the cup and the great development of the erect vertical and horizontal spicular lamellae.

Figure 6. A restoration of a segment of the surface showing the relative development of the successive series of reticulating lamellae, which produce a deep fenestration of the outer sponge-wall.

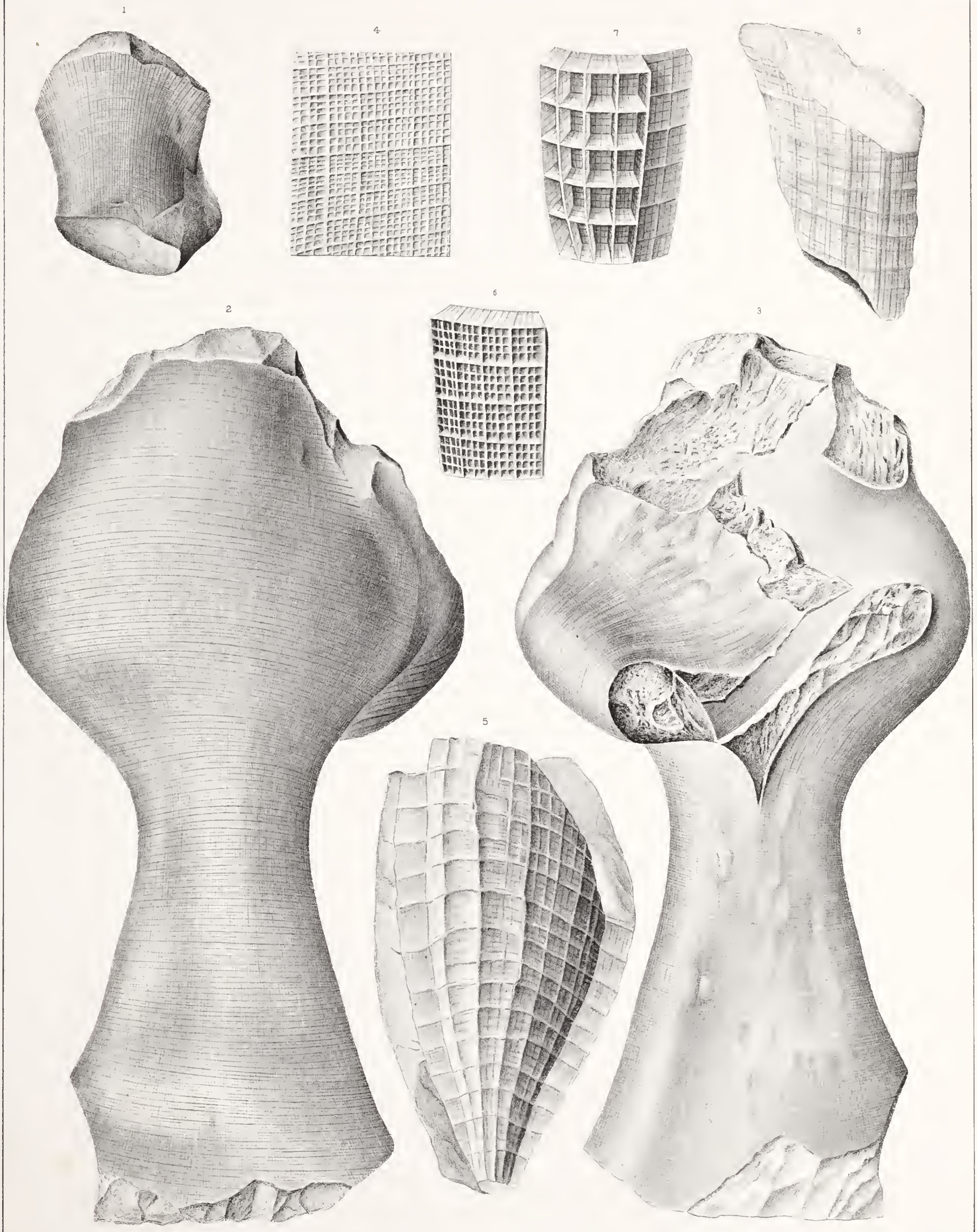
Figure 7. A restoration showing only the primary vertical and horizontal bands with the marks of subordinate lamellae upon their surface.

Figure 8. An internal cast showing the aspect of the fossil when divested of its exterior lamellae.
Waverly group. *Warren, Pennsylvania.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate XLIX.



R P W del

Philip Ast lith

PLATE L.

THAMNODICTYA, Hall.

Page 160.

(See Plates LII and LIII.)

THAMNODICTYA NEWBERRYI, Hall.

Page 161.

(See Plate LII.)

Figure 1. An entire frond showing its broad vase-shaped expansion and coarsely reticulate surface. This specimen is largely an internal cast in soft shale but retains the features of the exterior.

Figures 2, 3. Opposite sides of an internal cast of a small frond which has been ruptured along one side, but preserves a portion of the apertural margin and shows the disappearance of the coarse spicular bands, and the predominance of the finer net-work in this region.

Figure 4. An enlargement of a portion of the surface of an internal cast.

Figure 5. An internal cast of the expanded portion of a specimen.

Figure 6. An enlargement of a portion of the surface shown in fig. 1.

Waverly group. *Cuyahoga Falls, Ohio.*

CALATHOSPONGIA, gen. nov.

Page 155.

(See Plates XLVIII, XLIX, LI, LII, LVI, LVII, LX, LXVIII.)

CALATHOSPONGIA (?) SACCULUS, Hall (sp.).

Page 160.

Figure 7. A view of the specimen, showing its short subcylindrical, unexpanded form and the character of its reticulation.

Waverly group. *Richfield, Ohio.*

CLATHROSPONGIA, Hall.

Page 121.

(See Plates XIV, XV, XVIII, XXI, XXV, XLIX.)

CLATHROSPONGIA CAPRODONTA, sp. nov.

Page 154.

Figures 8, 9. Opposite sides of an essentially complete internal cast, which represents a long slender cup with a subprismatic surface and traces of low nodes at the angles of large quadrules. Only the coarser reticulation of the skeleton is apparent.

Waverly group. *Portsmouth, Ohio.*

DICTYOSPONGIDÆ.

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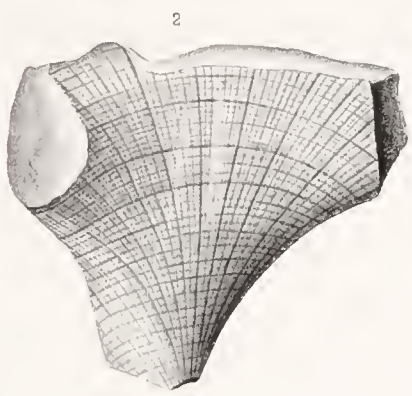

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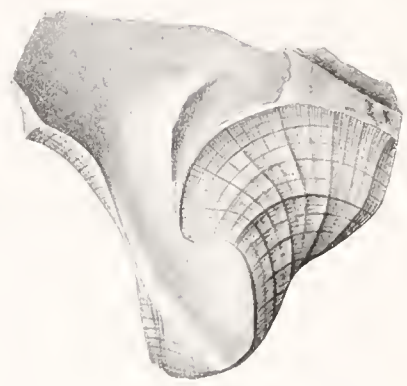

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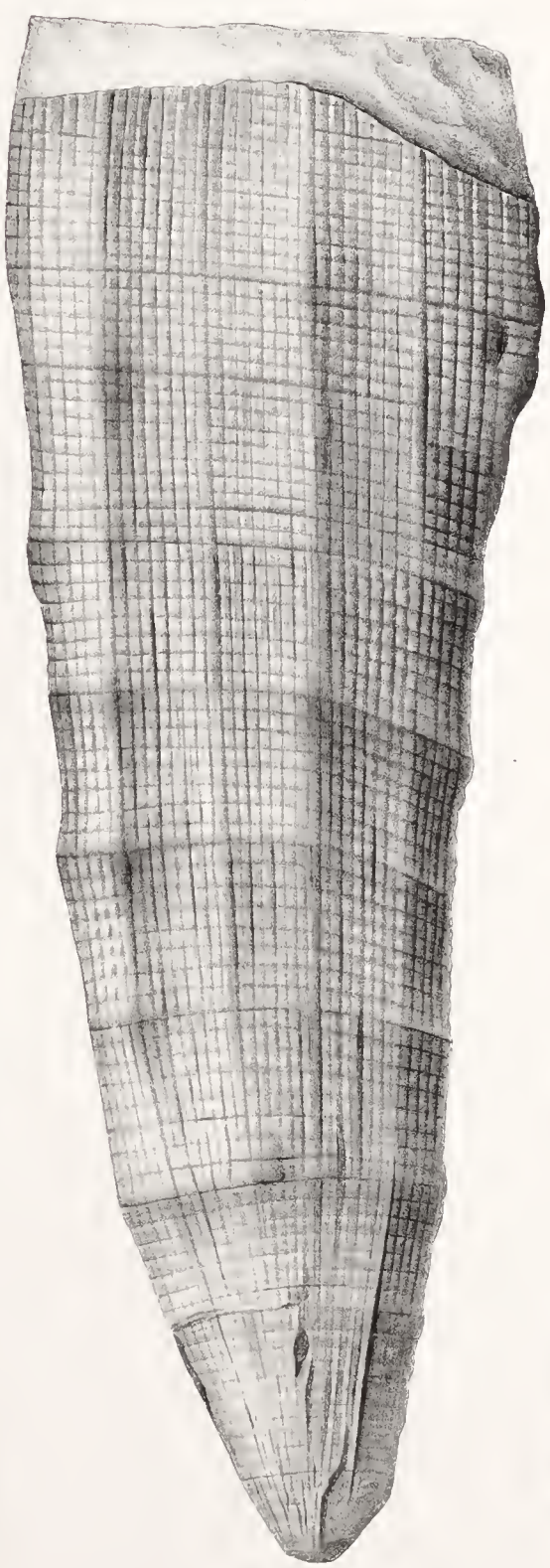

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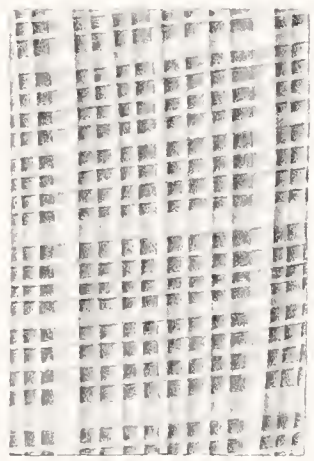

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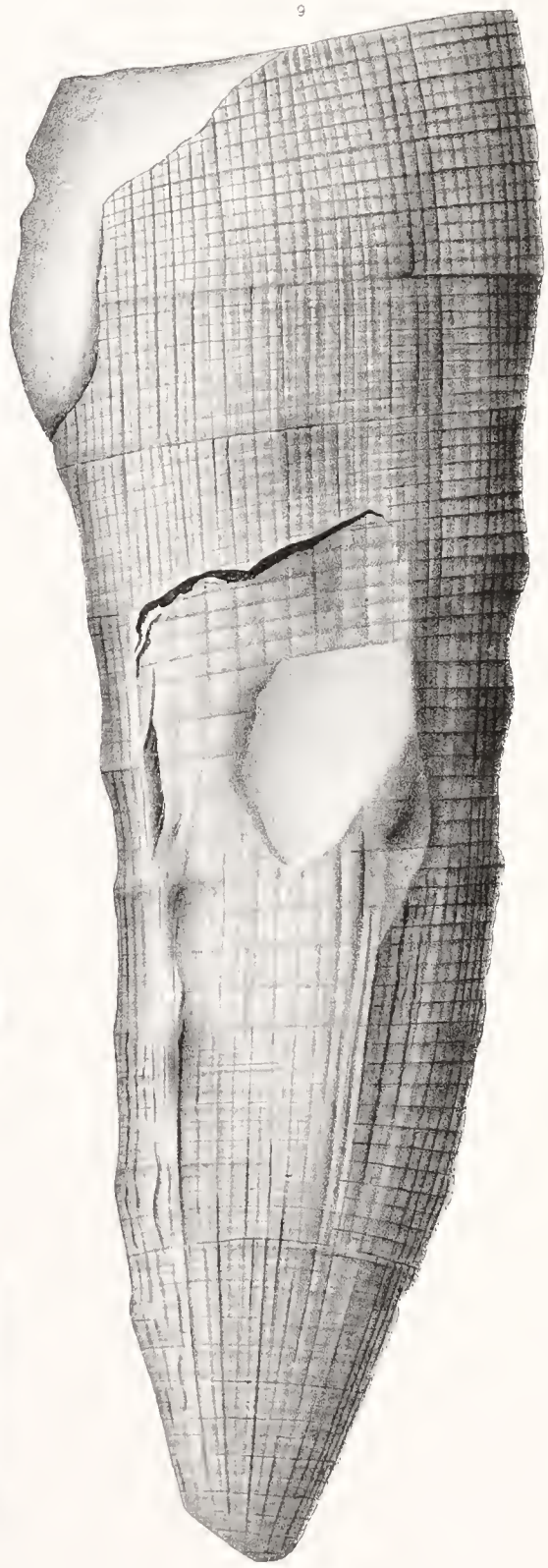

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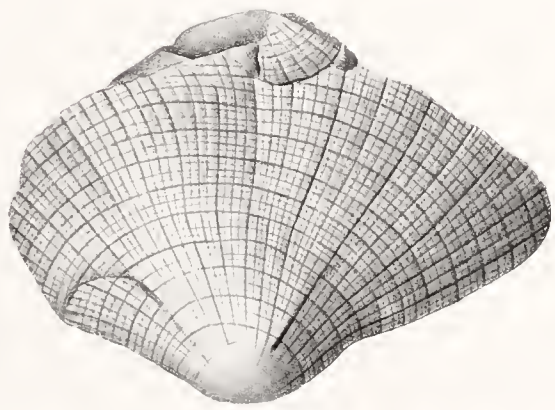

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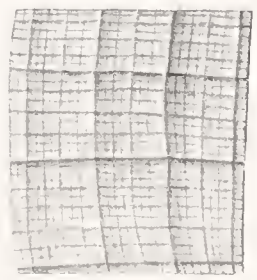

PLATE LI.

CLEODICTYA, Hall.

Page 163.

(See Plates LXIX and LXX.)

CLEODICTYA CLAYPOLEI, sp. nov.

Page 163.

Figure 1. An incomplete example, showing the small size of the sponge, the basal row of elongate nodes and the gradual, vase-like expansion above.

Waverly group. *Akron, Ohio.*

CALATHOSPONGIA, gen. nov.

Page 155.

(See Plates XLVIII, XLIX, L, LII, LVI, LVII, LX, LXVIII.)

CALATHOSPONGIA CARCERALIS, sp. nov.

Page 157.

(See Plates LII and LX.)

Figures 2, 3. Opposite sides of a specimen, evidently entire, but somewhat irregular at the aperture, and nearly complete at the base. The specimen shows the strong reticulation and the prominence of the primary bands, in which respect it is unlike other species referred to the genus, though agreeing with them in its form and broad base. The apertural margin, as shown in fig. 1, is entire and regular but the growth of the sponge seems to have been abruptly stopped on this side, as, upon the opposite surface, it is continued for a considerable distance further upward. This is evidently not due to a distortion of the skeleton for the horizontal bands may be traced continuously about the surface without deviation from their plane.

Figure 4. A larger, nearly complete specimen. This is a figure which was used in the original illustration of *Dictyophyton Newberryi* (Sixteenth Annual Report of the N. Y. State Cabinet, pl. iv, fig. 3), but the surface represented shows much less distinctly than the opposite side of the specimen the coarse primary quadrules and spicular bands.

Waverly group. *Richfield, Ohio.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate LI

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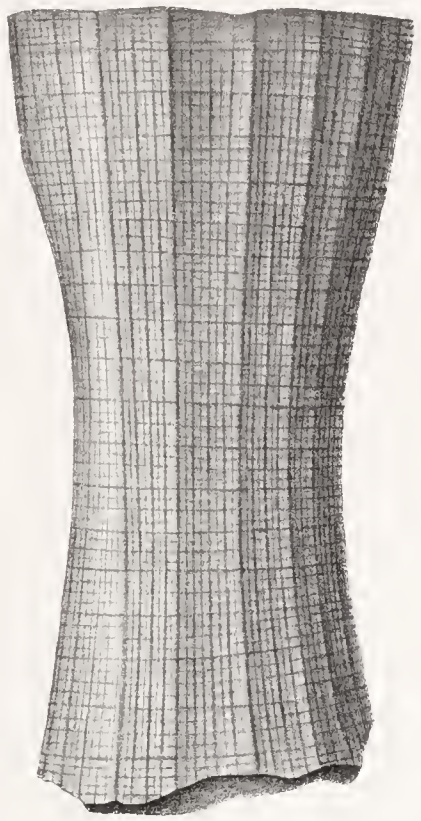

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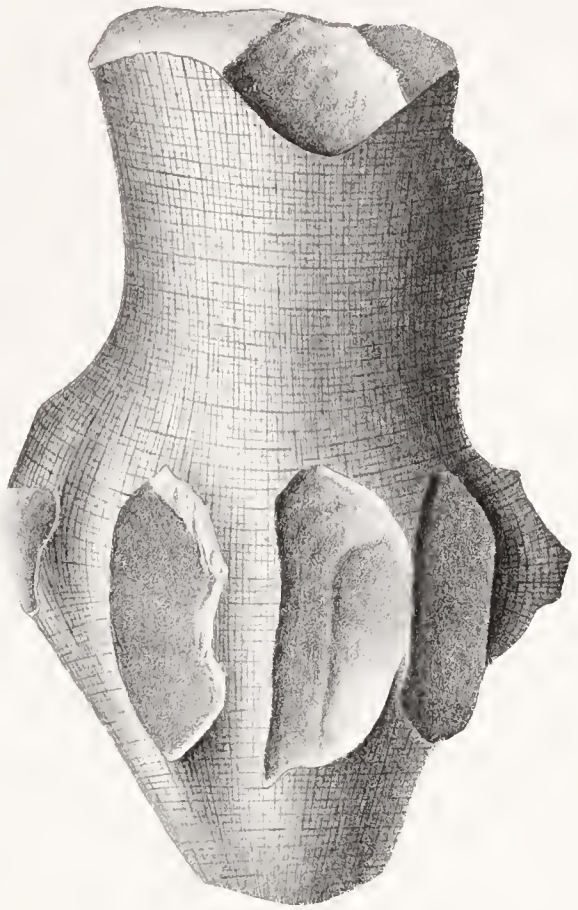

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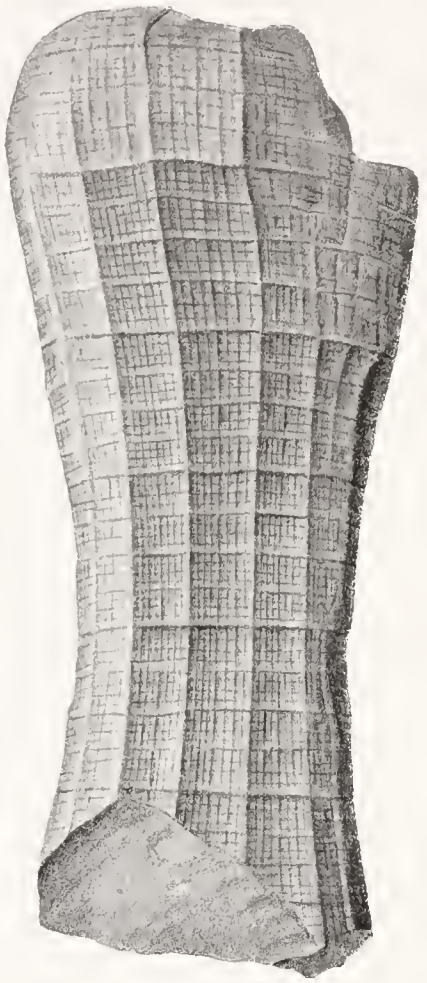

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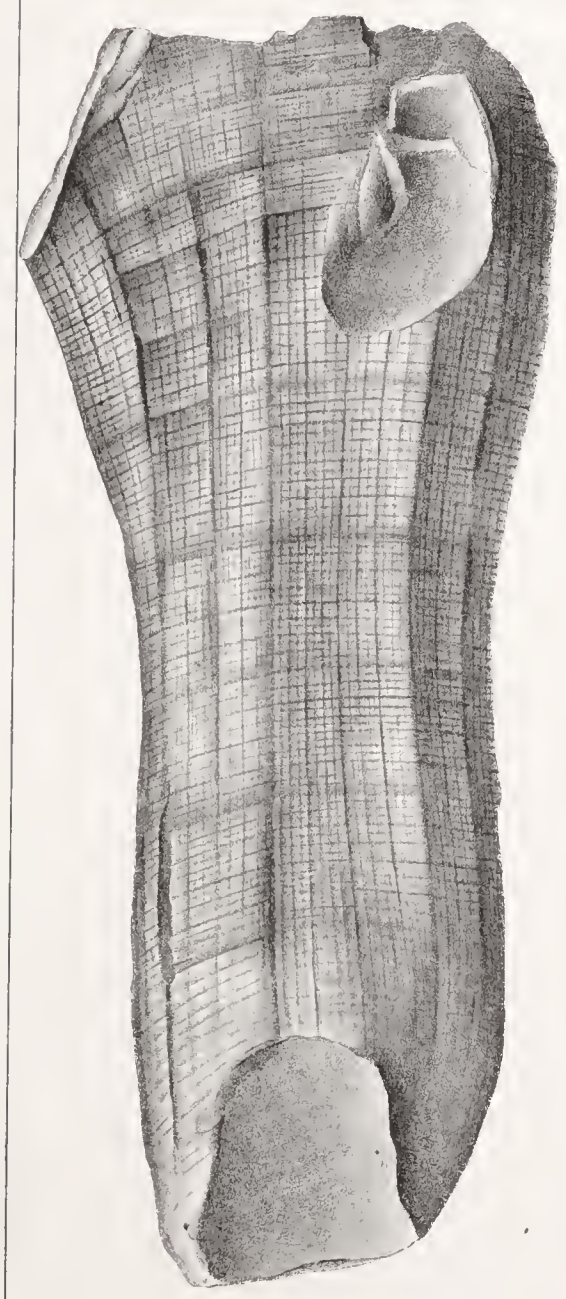

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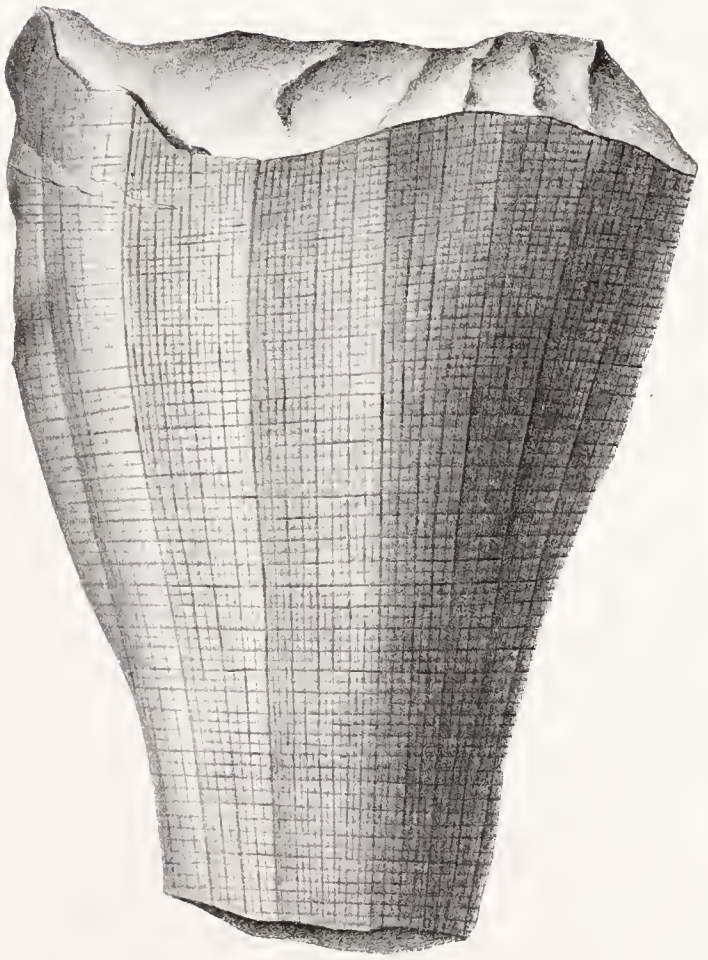

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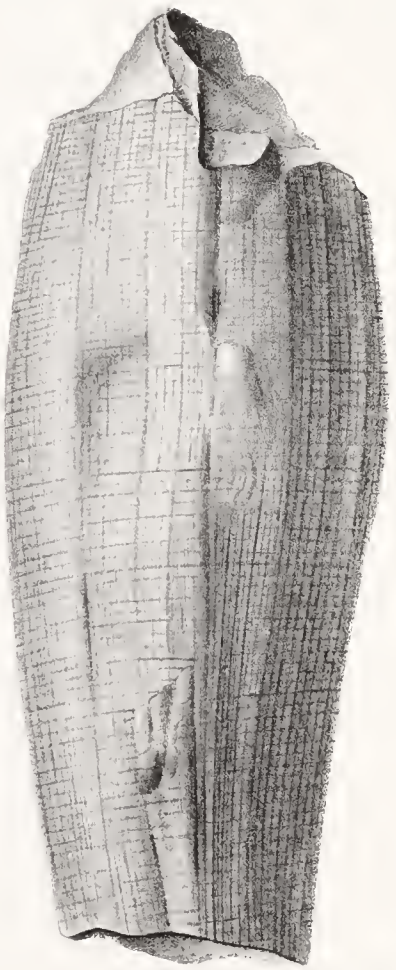


G.B Simpson del

Philip Ast lith

CALATHOSPONGIA TIFFANYI, sp. nov.

Page 158.

Figures 5, 6. Views of a somewhat compressed specimen showing the rate of expansion of the sponge and its obscurely prismatic surface. Waverly group. *Ohio* (*precise locality not known*).

PLATE LII.

THAMNODICTYA, Hall.

Page 160.

(See Plates L and LIII.)

THAMNODICTYA NEWBERRYI, Hall.

Page 161.

(See Plate L.)

Figure 1. The upper vase-shaped part of a large individual, the apertural portion being bent down and flattened.

Waverly group. *Richfield, Ohio.*

CALATHOSPONGIA, gen. nov.

Page 155.

(See Plates XLVIII, XLIX, L, LI, LVI, LVII, LX, LXVIII.)

CALATHOSPONGIA CARCERALIS, sp. nov.

Page 157.

(See Plates LI and LX.)

Figure 2. An essentially entire example with well developed prism-faces.

Figure 3. A small individual with obscure prismatic division.

Waverly group. *Richfield, Ohio.*

CALATHOSPONGIA CARLLI, sp. nov.

Page 158.

Figures 4, 5. Two views of a nearly entire but somewhat distorted specimen, showing the narrow basal part and wide apertural expansion.

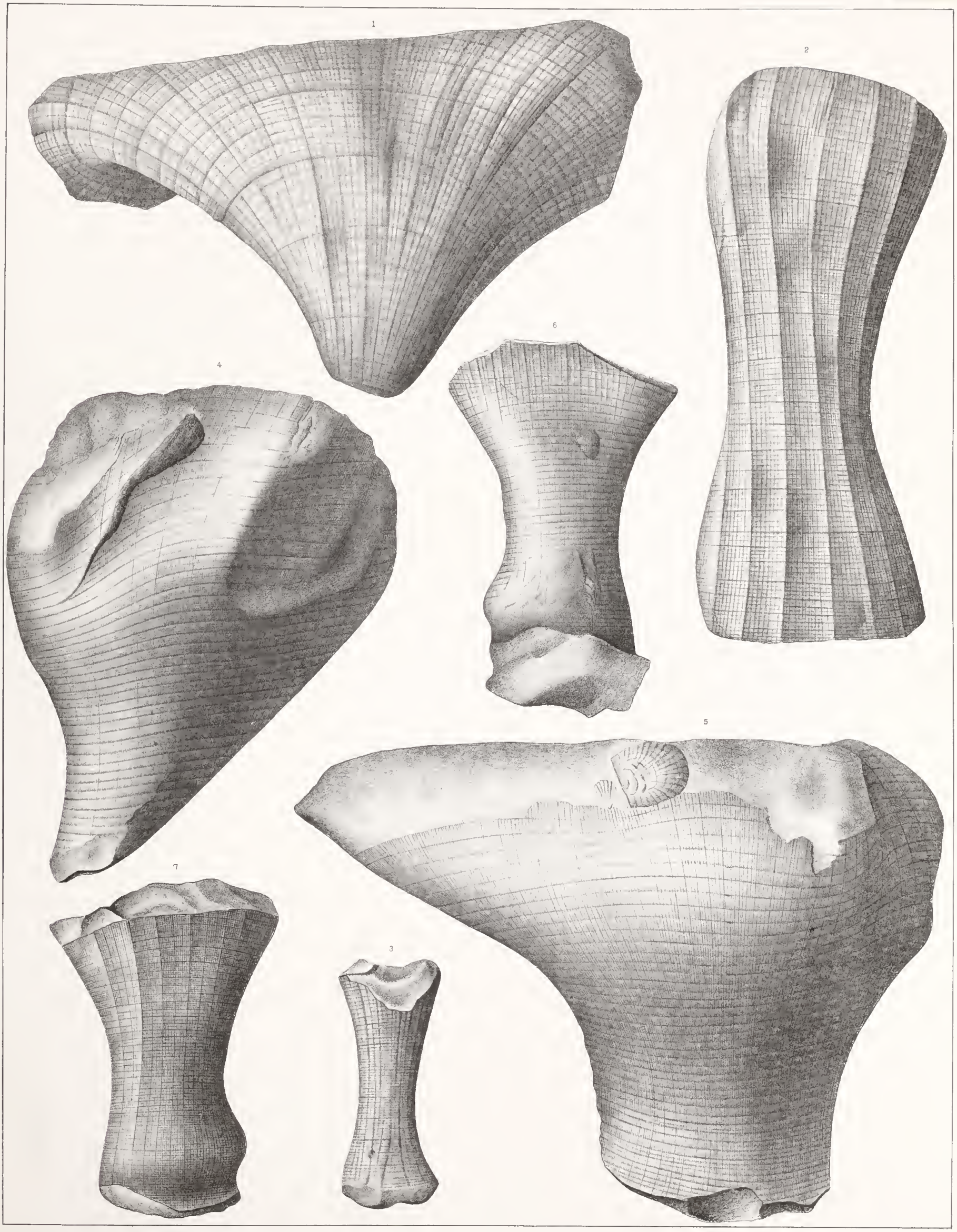
Figures 6, 7. Opposite sides of a small example, essentially entire at both extremities.

Waverly group. *Near Pleasantville, Venango county, Pennsylvania.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate LII



G.B Simpson del.

Philip Ast lith

PLATE LIII.

THAMNODICTYA, Hall.

Page 160.

(See Plates L and LII.)

THAMNODICTYA ORTONI, sp. nov.

Page 162.

Figures 1, 2. Opposite sides of a specimen which is an internal cast of the expanded apertural portion of the sponge, the smooth lower point representing the place of attachment of the pedicel. The species is characterized by the fineness of the reticulation, the peculiar curvature of the vertical bands and its large size.

Waverly group. *Moot's Run, Licking county, Ohio.*

THYSANODICTYA, gen. nov.

Page 125.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII.)

THYSANODICTYA EXPANSA, Hall (sp.).

Page 154.

Figure 3. A large basal disc or diaphragm characterized by its irregularly radiating spicular bands and nodose periphery. This represents an individual of great size.

Waverly group. *Warren, Pennsylvania.*

TYLODICTYA, gen. nov.

Page 151.

TYLODICTYA (?) TENUIS, Hall (sp.).

Page 152.

Figure 4. A small portion of a frond showing two double nodes, one more distinctly divided. Drawn from a cast of the original impression.

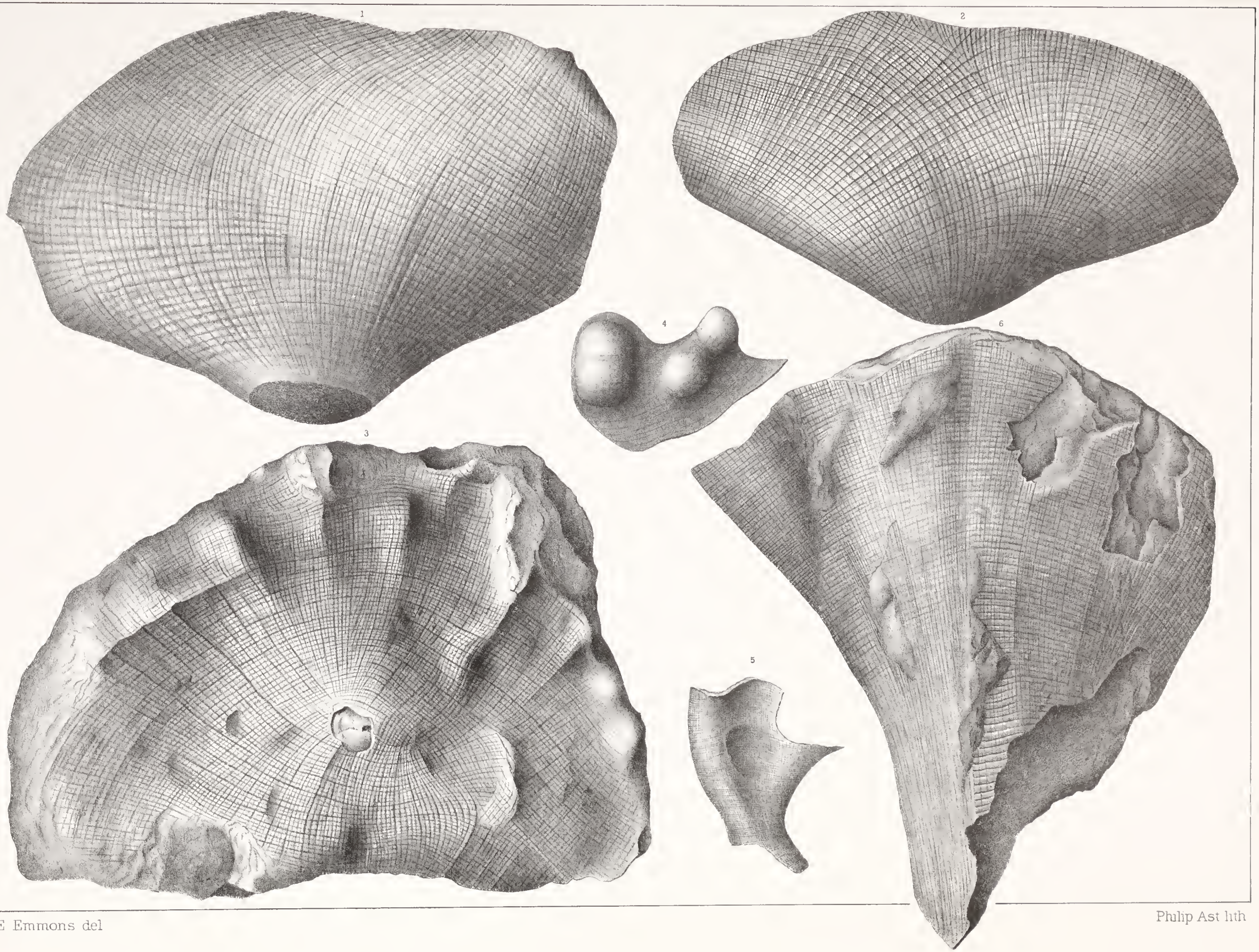
Figure 5. The original illustration of this species, showing the impression of one of the double nodes and the extremely fine reticulation of the surface, but with the specimen oriented differently than in fig. 4.

Waverly group. *Warren, Pennsylvania.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate LIII.



E Emmons del

Philip Ast lith

LYRODICTYA, Hall.

Page 170.

(See Plate LVI.)

LYRODICTYA (?) BURLINGTONENSIS, Hall (sp.).

Page 165.

Figure 6. A view of the original specimen, which is a fragment of a broadly expanded frond with strong bundles of vertical spicules, compacted at the base but diffused toward the apertural portion. The reticulation is uniformly fine.

Burlington group (Yellow sandstones). *Burlington, Iowa.*

PLATE LIV.

ACLŒODICTYA, gen. nov.

Page 177.

(See Plates LV, LX, LXI, LXVIII.)

ACLŒODICTYA ECCENTRICA, Hall (sp.).

Page 179.

Figure 1. A basal disc, somewhat compressed on one side but showing the continuity of the radial striae across the apical region, in two sets reticulating with each other.

Figure 2. A portion of a larger disc showing a tendency to the formation of elongate nodes or ridges near the periphery.

Keokuk group. *Crawfordsville, Indiana.*

(?) ECTENODICTYA, Hall.

Page 164.

(?) ECTENODICTYA IMPLEXA, Hall.

Page 164.

Figure 3. A large irregularly enfolded frond which has been much weathered. The net-work is very fine but is crossed by stronger horizontal bands like those in fig. 4, though these are much obscured in the specimen and are not represented in the drawing. Enclosed in this specimen is the original example of *Clathrospongia abacus*, figured upon Plate xlix.

Waverly group. *Warren, Pennsylvania.*

Figure 4. Another fragmentary sponge, showing the horizontal bands of the reticulum.

Waverly group. *Oil City, Pennsylvania.*

Both of these specimens have a reticulum very similar to that characterizing *Calathospongia Redfieldi* and *C. Carlli*, and it is probable that such incomplete examples are to be referred to one or the other of these species.

DICTYOSPONGIDÆ.

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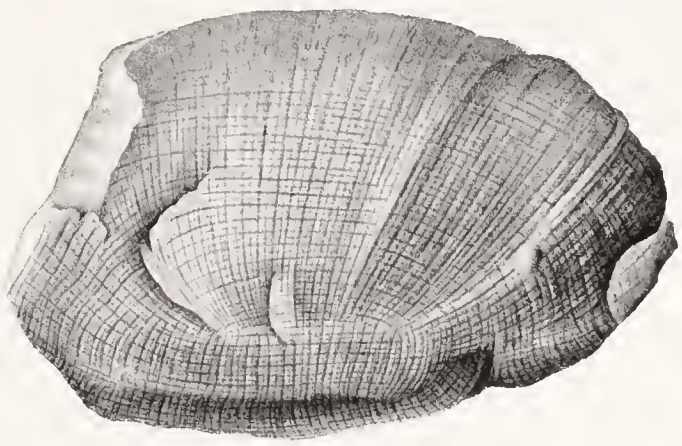

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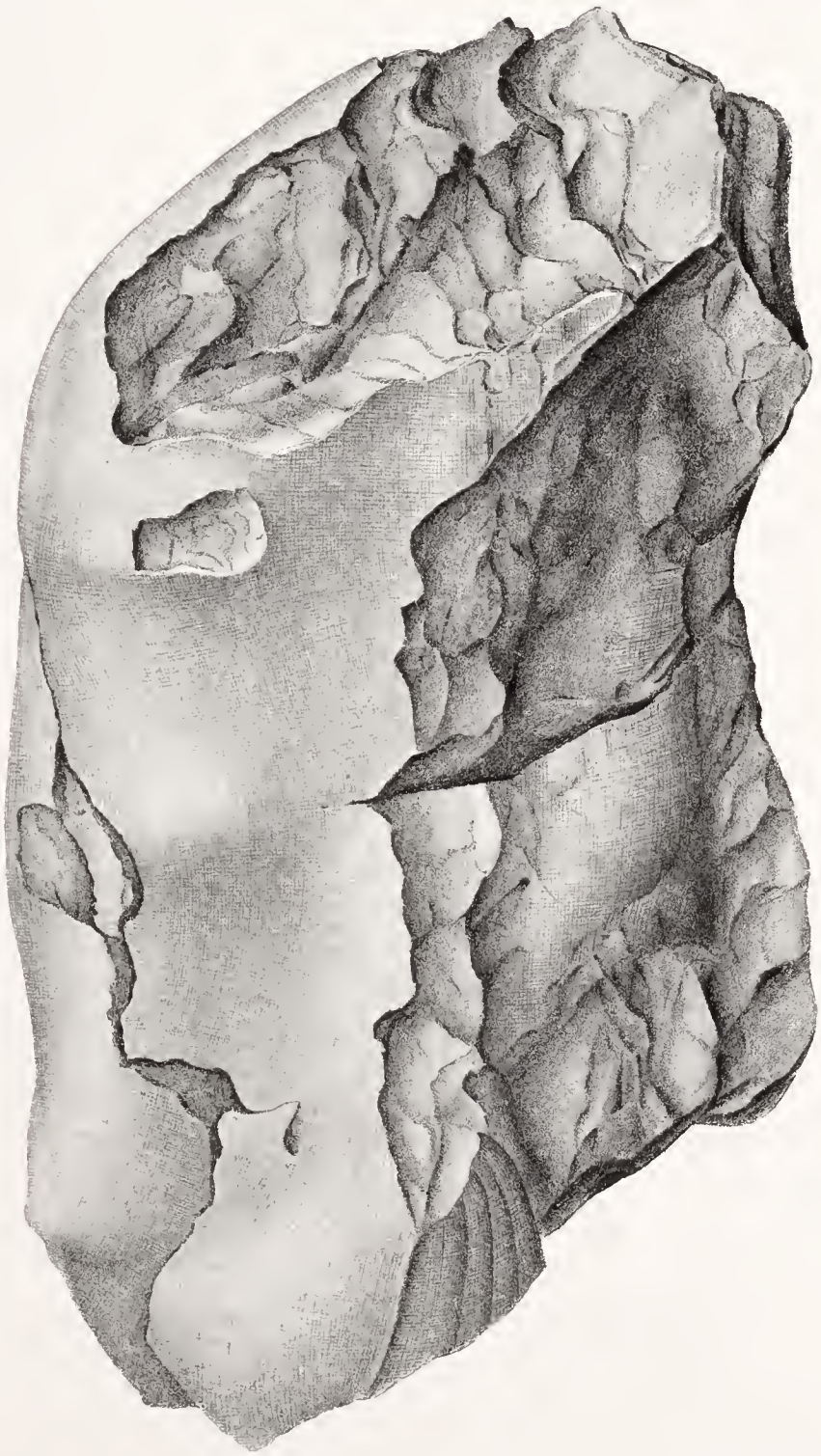

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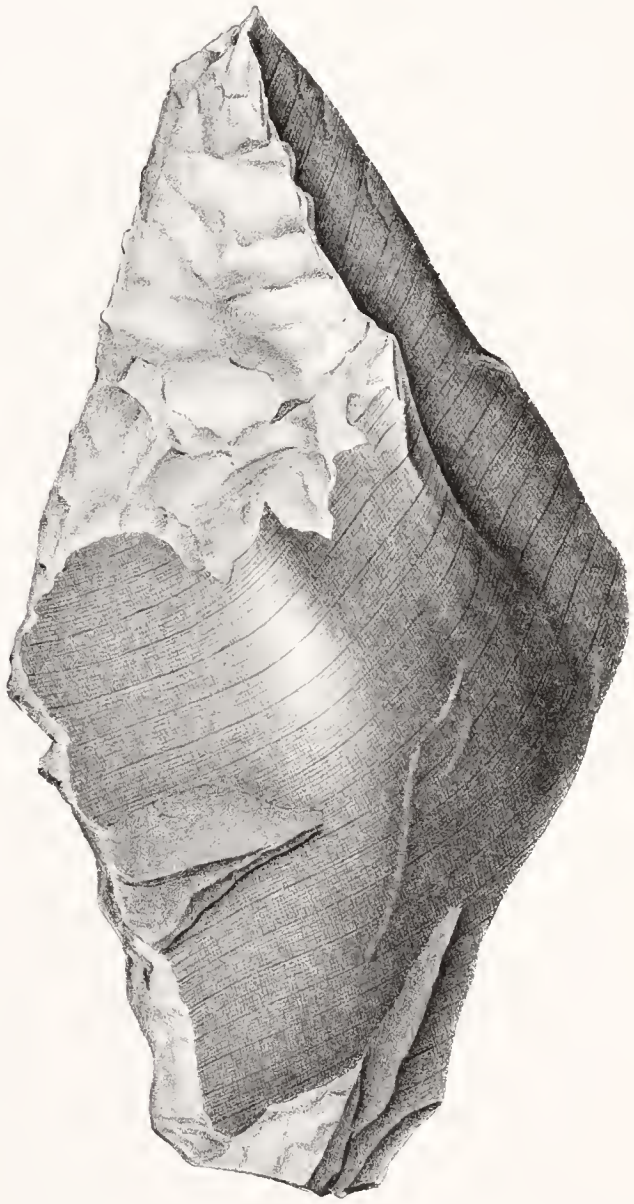


E Emmons del

Philip Ast lith

PLATE LV.

PRISMODICTYA, gen. nov.

Page 79.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII.)

PRISMODICTYA POLYHEDRA, sp. nov.

Page 168.

Figures 1, 2. Opposite sides of the original specimen.
Keokuk group. *In the shales at Crawfordsville, Indiana.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LVI, LXI.)

DICTYOSPONGIA CYLINDRICA, Whitfield (sp.).

Page 166.

Figure 3. View of the original specimen retaining the pyritized skeleton.
Keokuk group. *Crawfordsville, Indiana.*

ACLŒODICTYA, gen. nov.

Page 177.

(See Plates LIV, LX, LXI, LXVIII.)

ACLŒODICTYA MARSIPUS, sp. nov.

Page 178.

(See Plates LX, LXI, LXVIII.)

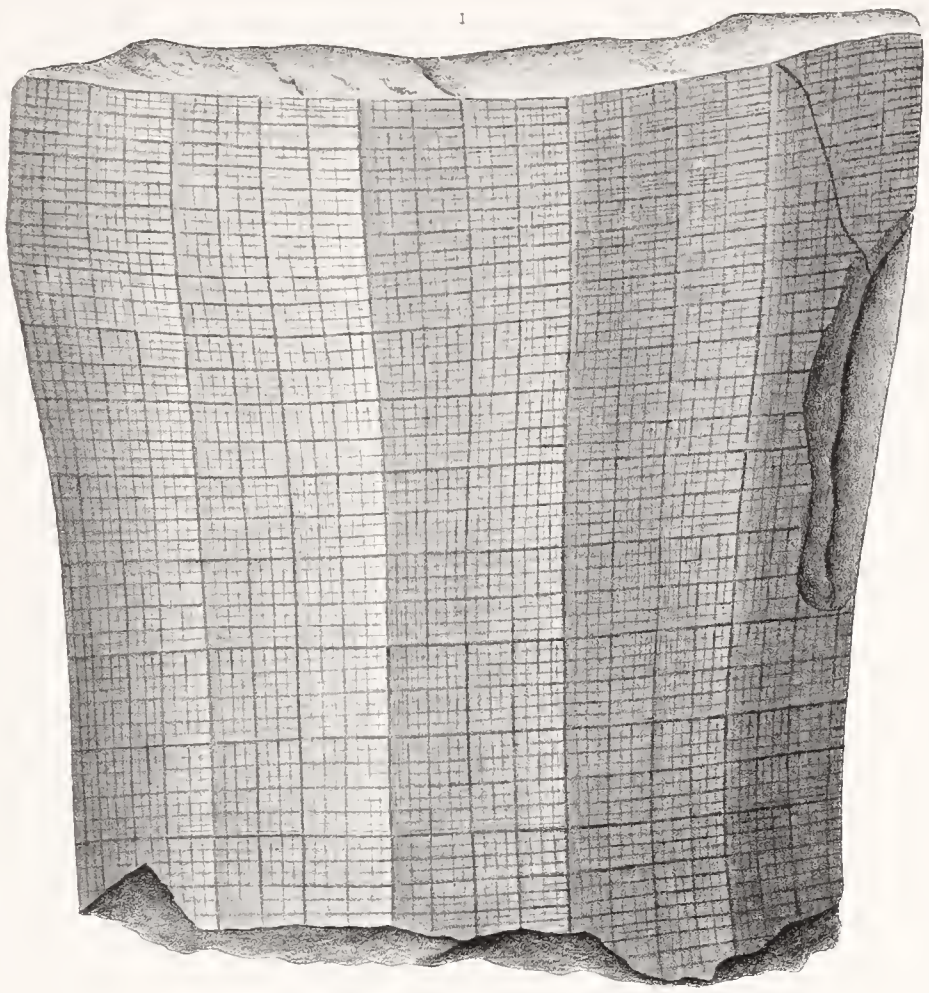
Figure 4. Portion of the specimen with pyritized skeleton; showing the extent of one of the vertical lamellae of the outer wall of the sponge.
Keokuk group. *Crawfordsville, Indiana.*

(?) LYRODICTYA, Hall.

Figure 5. Enlargement of a part of the surface of a young sponge which probably belongs to a species of this genus; showing the pyritized spicular rods of two of the vertical bundles. The quadrules bear faint traces of a fine reticulation. x3.
Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

1



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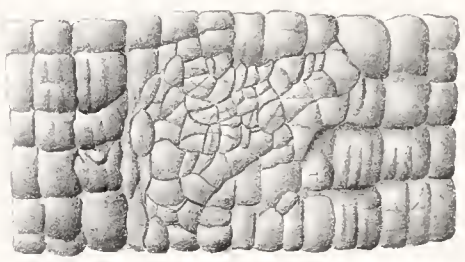

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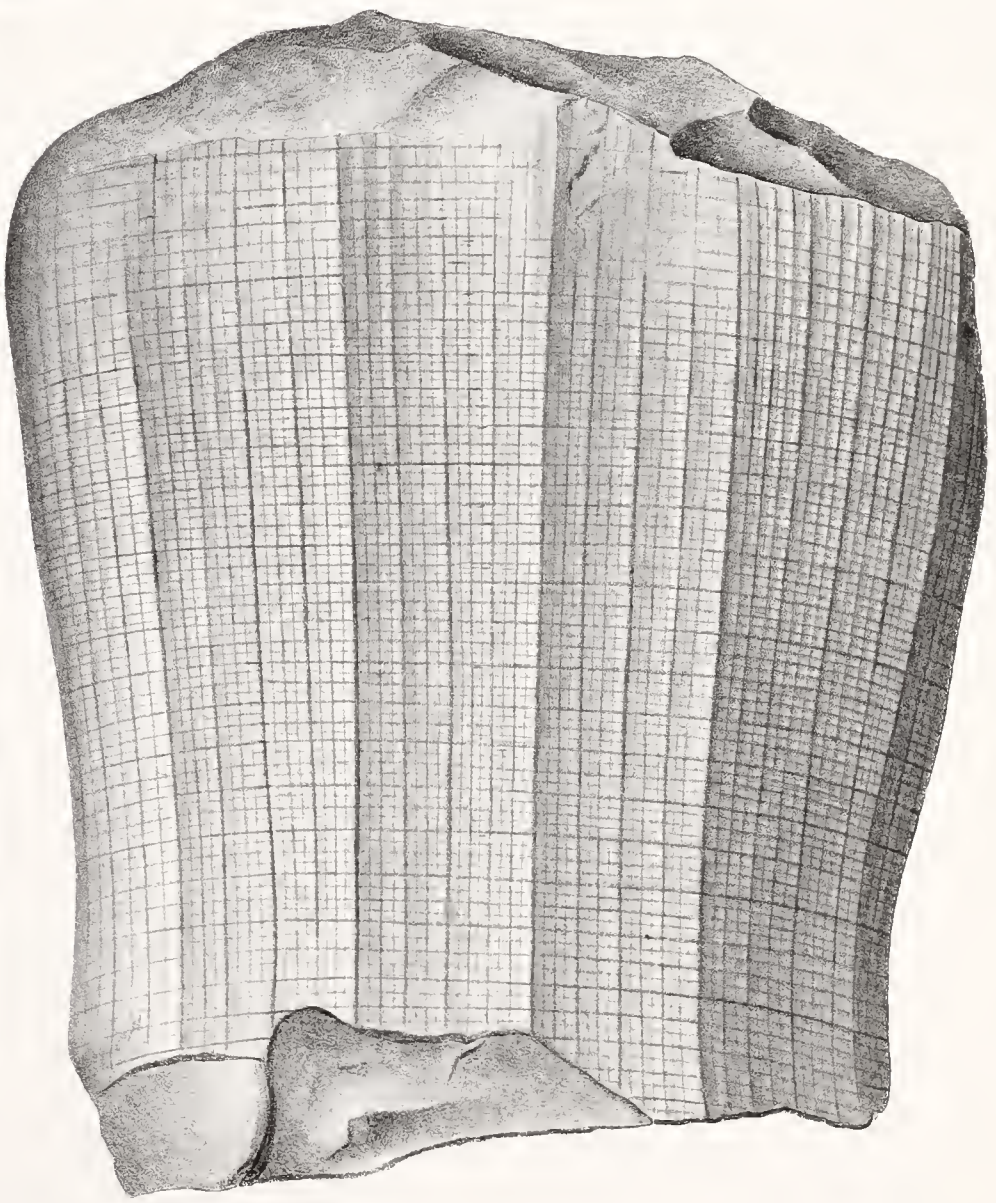

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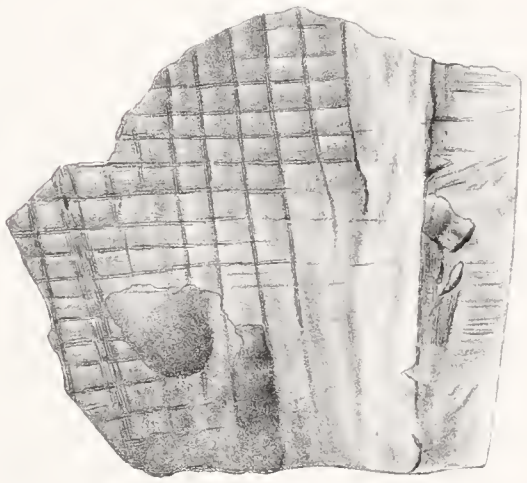

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6

GRIPHODICTYA, gen. nov.

Page 179.

GRIPHODICTYA EPIPHANES, sp. nov.

Page 180.

Figure 6. The specimen from which the spicules represented on page 180 were taken. This sponge has to some degree the aspect of *Phragmodictya catilliformis*, but its characteristic spicules have not been found in any other species.
Keokuk group. *Crawfordsville, Indiana.*

HYDRIODICTYA, gen. nov.

Page 77.

(See Plates IV, V, XVI, XXI.)

HYDRIODICTYA CYLIX, sp. nov.

Page 78.

(See Plates V and XVI.)

Figure 7. An enlargement of a portion of the specimen given on Plate xvi, fig. 2, showing a part of the repaired net-work of the skeleton.
Chemung group. *Deyo basin, Naples, N. Y.*

PLATE LVI.

LYRODICTYA, Hall.

Page 170.

(See Plates LIII and LV.)

LYRODICTYA ROMINGERI, Hall.

Page 170.

Figure 1. A view of the original specimen; showing the strong bundles of rod-like, vertical spicules which are increased in number upward, by intercalation, and also the finer reticulation over the broad interspaces, in which the horizontal impressions predominate.

Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LXI.)

DICTYOSPONGIA (?) STYLINA sp. nov.

Page 167.

Figure 2. A long, slender, sponge-like body bearing horizontal and vertical striae near the top. The true character of this fossil is not fully determined but it is illustrated here on account of its resemblance to forms of DICTYOSPONGIA.

Keokuk group. *Crawfordsville, Indiana.*

PHYSOSPONGIA, Hall.

Page 187.

(See Plates LXI, LXII, LXIII.)

PHYSOSPONGIA, sp.?

Figure 3. A portion of the upper part of a small example in which the primary reticulating bundles of spicules are retained in a pyritized condition, while the outer portions of the skeleton are lost.

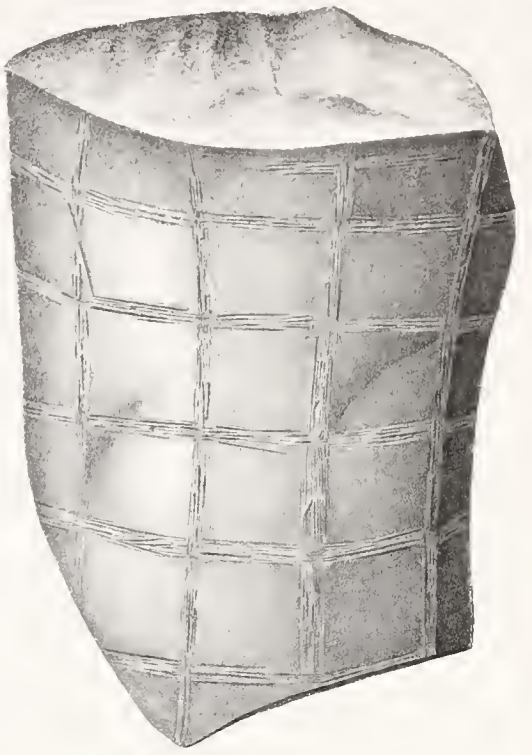
Figure 4. An enlargement of the same specimen to three diameters, showing the square and regular quadrules made by the intersecting bundles. The specimen is interesting in showing that in youth the surface of the sponge is without nodes or depressions, and it may be compared with the similar condition exhibited by the senile stage shown in figure 4, Plate lxiii.

Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

1

2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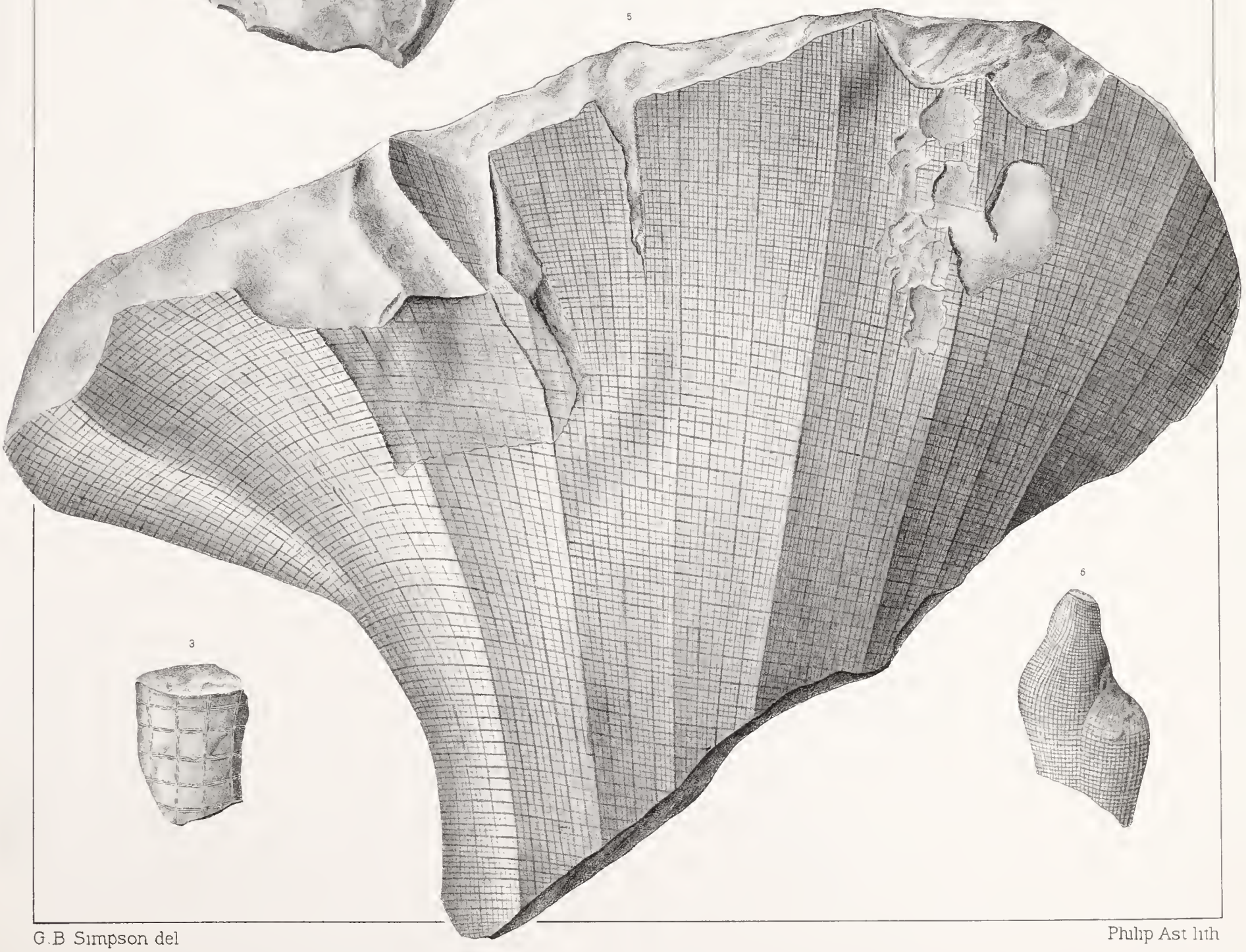
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G.B Simpson del

Philp Ast lith

CALATHOSPONGIA, gen. nov.

Page 155

(See Plates XLVIII, XLIX, L, LI, LII, LVII, LX, LXVIII.)

Calathospongia (?) magnifica, sp. nov.

Page 182.

(See Plate LVII.)

Figure 5. The expanded apertural portion of a large sponge showing subprismatic faces.

Keokuk group. *Crawfordsville, Indiana.*

MASTODICTYA, gen nov.

Page 167.

Dictyospongia (Mastodictya) osculata, sp. nov.

Page 167.

Figure 6. A view of the specimen described; showing the conical prolongation at the left, terminating in an osculum, the imperfect portion at the right probably representing a similar process. The reticulum is very fine, its meshes being of uniform size.

Keokuk group. *Crawfordsville, Indiana.*

PLATE LVII.

CALATHOSPONGIA, gen. nov.

Page 155.

(See Plates XLVIII, XLIX, L, LI, LII, LVI, LX, LXVIII.)

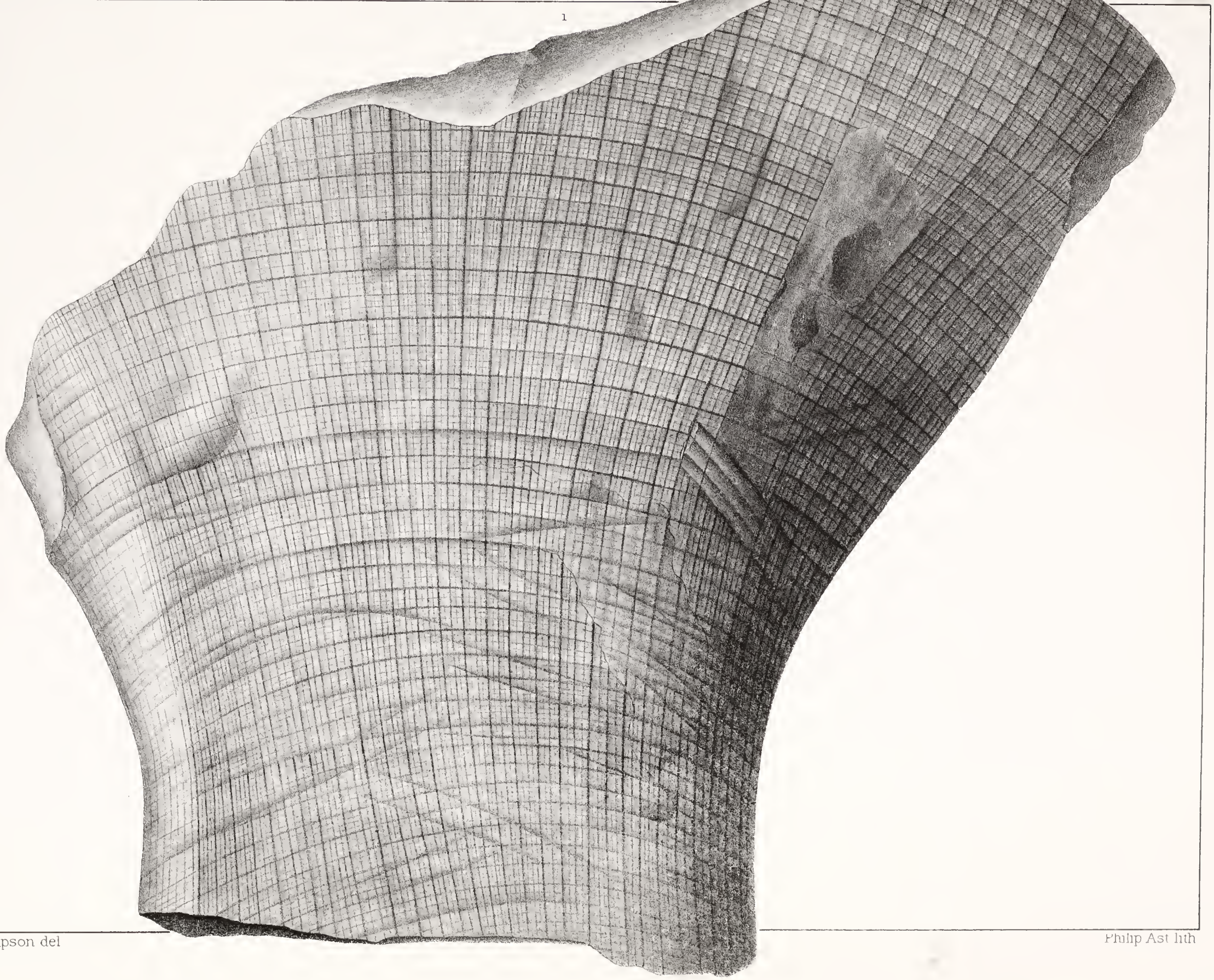
CALATHOSPONGIA (?) MAGNIFICA, sp. nov.

Page 182.

(See Plate LVI.)

Figure 1. The upper portion of a very large example, retaining a part of the body and enough of the apertural expansion to show its extent. Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.



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Philip Ast lith

PLATE LVIII.

LEBEDICTYA, gen. nov.

Page 169.

(See Plates LIX and LXI.)

LEBEDICTYA CRINITA, sp. nov.

Page 169.

(See Plates LIX and LXI.)

Figures 1, 2. Opposite sides of a specimen, probably representing most of the sponge, retaining the aperture complete and showing its marginal fringe of long spicules. The cup has an essentially smooth, gently expanding, slightly prismatic surface; the face exposed in fig. 2 showing the finer net-work and the uneven growth of the reticulum at the margin, while the surface represented in fig. 1 shows traces of the erect outer spicular lamellae which form coarse quadrules, and at the right, where exfoliated, a large internal bundle of vertical spicules.

Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate LVIII

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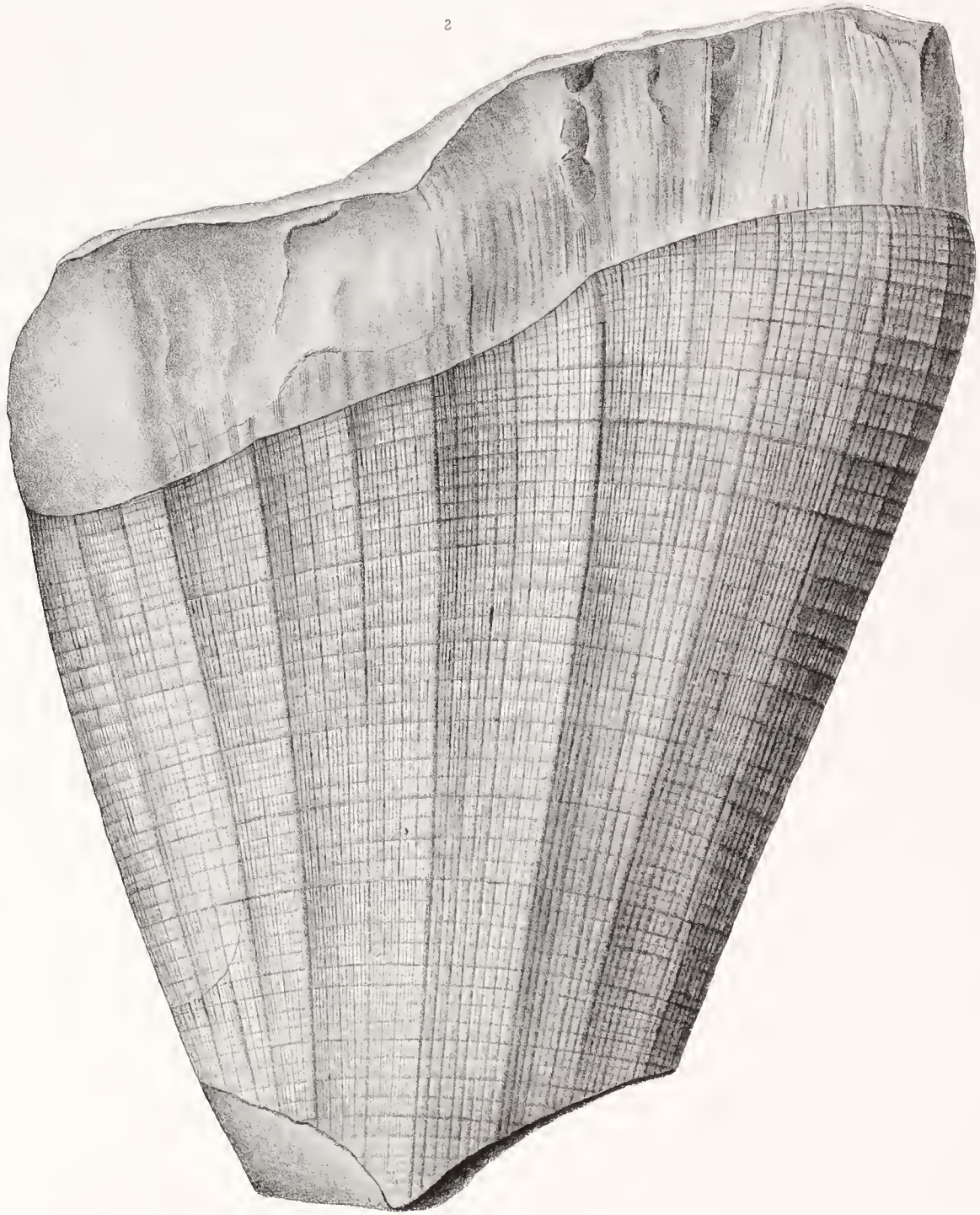
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Philip Ast lith

PLATE LIX.

LEBEDICTYA, gen. nov.

Page 169.

(See Plates LVIII and LXI.)

LEBEDICTYA CRINITA, sp. nov.

Page 169.

(See Plates LVIII and LXI.)

Figure 1. The apertural portion of a cup showing the marginal fringe.

Figure 2. A large, obliquely compressed cup exhibiting about one-half of the apertural margin and its spicular fringe. In both of these specimens it is seen that there is a difference in the strength of the spicules composing the fringe, the coarser seeming to lie in the line of the coarser vertical bundles of the reticulum.

Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

1

2

G.B. Simpson del.

Philp Ast lith

PLATE LX.

CALATHOSPONGIA, gen. nov.

Page 155.

(See Plates XLVIII, XLIX, L, LI, LII, LVI, LVII, LXVIII.)

CALATHOSPONGIA CARCERALIS, sp. nov.

Page 157.

(See Plates LI and LII.)

Figures 1, 2. Opposite sides of a complete specimen, the side represented in fig. 1 having been somewhat abraded. This specimen shows the form of the entire sponge from apertnre to base, the abrupt truncation of the latter, without evidence of basal disc, the stout body and gradnal expansion toward the summit. The major quadrules of the reticulum are somewhat less conspicuous than those on the specimens from the Waverly sandstone represented on Plates li and lii, but this difference is largely due to the mode of preservation.
Keokuk group. *Crawfordsville, Indiana.*

ACLŒODICTYA, gen. nov.

Page 177.

(See Plates LIV, LV, LXI, LXVIII.)

ACLŒODICTYA MARSIPUS, sp. nov.

Page 178.

(See Plates LV, LXI, LXVIII.)

Figure 3. Lateral aspect of an incomplete specimen showing a coarsely reticulated surface and the deep basal obcone with its somewhat irregular reticulation.

Figure 4. Side view of a small and somewhat distorted specimen with a finer reticulation.

Figure 5. An entire individual, showing a very stout subcylindrical cup with a coarse, square reticulation. The basal obcone is relatively deep, forming a very obtuse angle with the walls of the sponge, and shows the absence of any peripheral fringe and also the irregular convergence and intersection of the radial bands.
Keokuk group. *Indian Creek, Indiana.*

DICTYOSPONGIDÆ.

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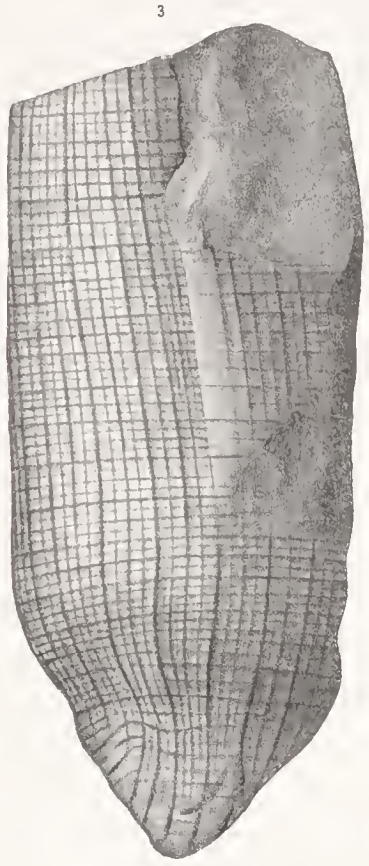

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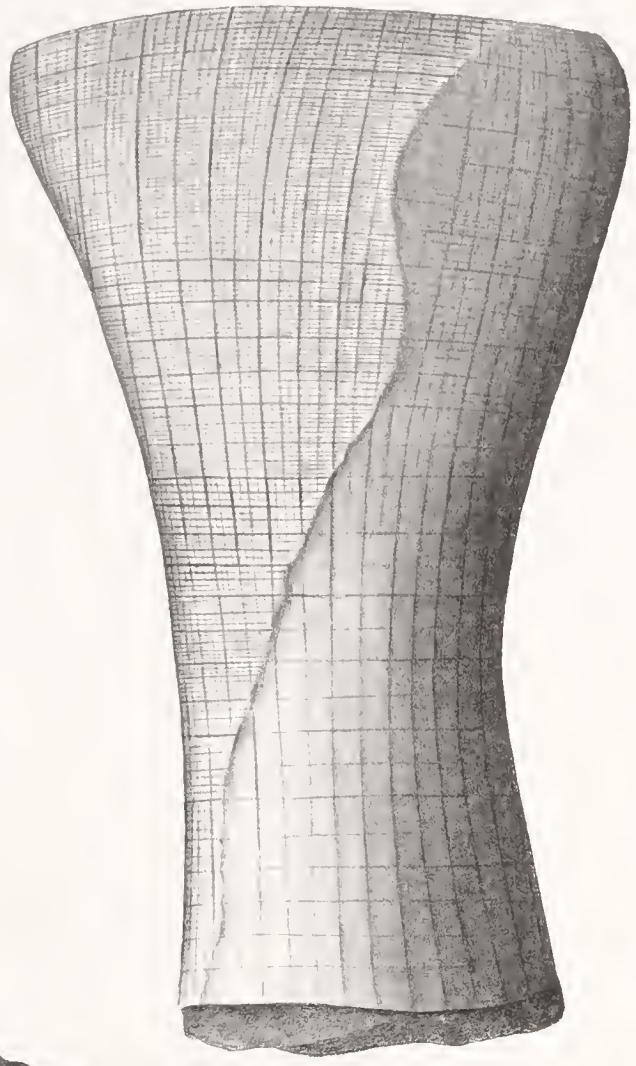

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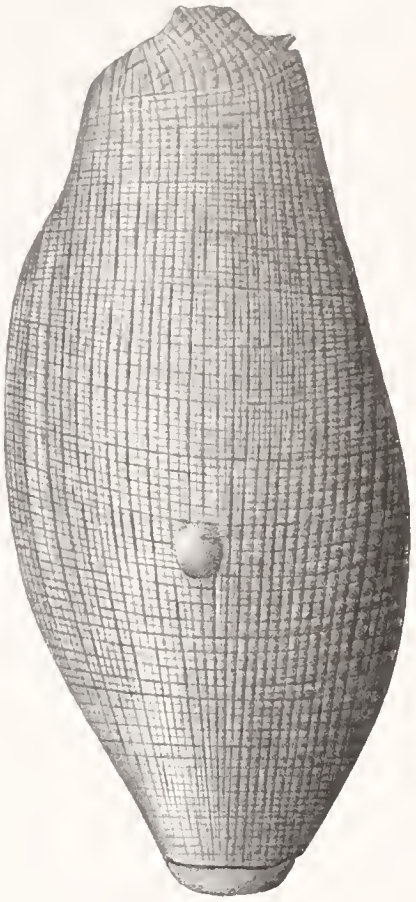

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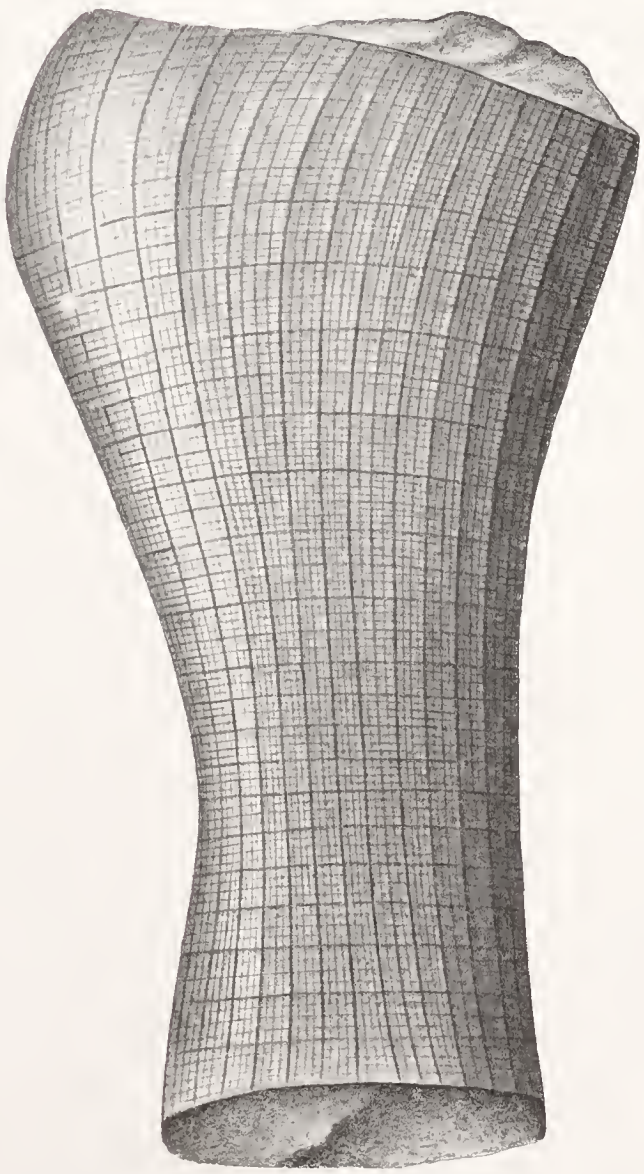

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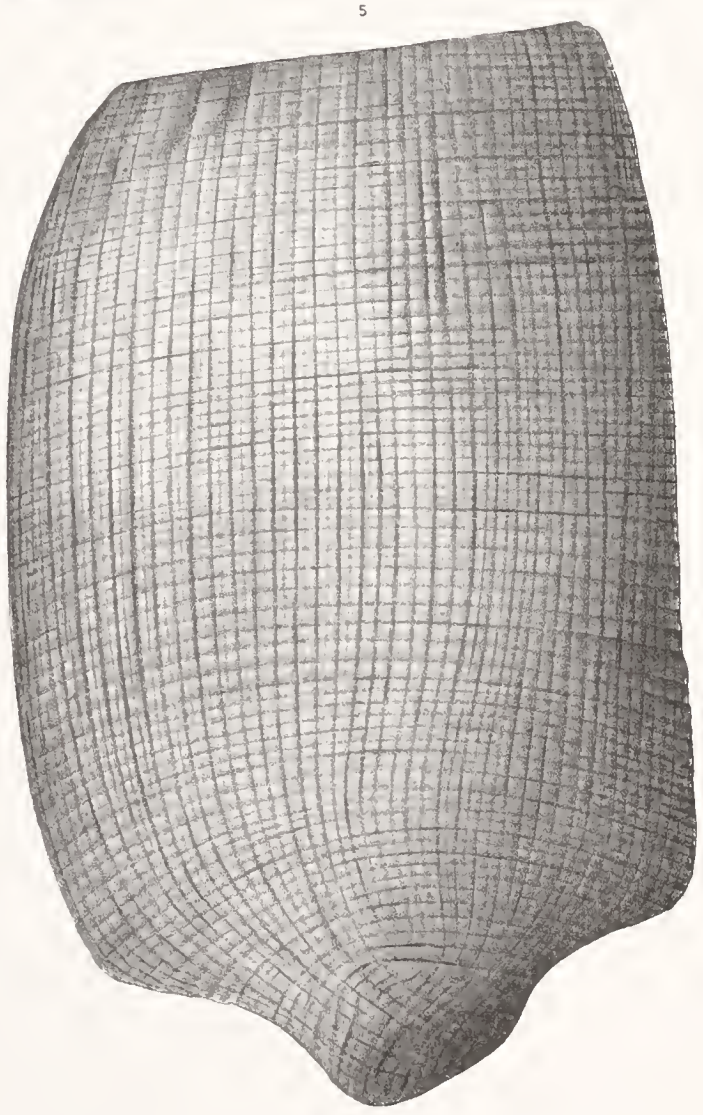

PLATE LXI.

ACLŒODICTYA, gen. nov.

Page 177.

(See Plates LIV, LV, LX, LXVIII.)

ACLŒODICTYA MARSIPUS, sp. nov.

Page 178.

(See Plates LV, LX, LXVIII.)

Figures 1, 2. Opposite sides of the lower portion of a cup which is referred with doubt to this species.

Figure 3. A portion of the body of a cup which has retained impressions of the erect surface lamellae.

Keokuk group. *Crawfordsville, Indiana.*

PHRAGMODICTYA, Hall.

Page 172.

(See Plates LXIV, LXV, LXVI, LXVII, LXVIII.)

PHRAGMODICTYA (?) CREBRISTRIATA, Hall.

Page 176.

Figure 4. A view of the original specimen which appears to be a fragment of the apertural portion of a very finely reticulated sponge.

Keokuk group. *Crawfordsville, Indiana.*

LEBEDICTYA, gen. nov.

Page 169.

(See Plates LVIII and LIX.)

LEBEDICTYA CRINITA, sp. nov.

Page 169.

(See Plates LVIII and LIX.)

Figure 5. A portion of a small specimen showing the apertural fringe.

Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIA, gen. nov.

Page 72.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI.)

DICTYOSPONGIA CYLINDRICA, Whitfield (sp.).

Page 166.

(See Plate LV.)

Figure 6. A fragment of a small example with pyritized spicules.

Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate LXI

1

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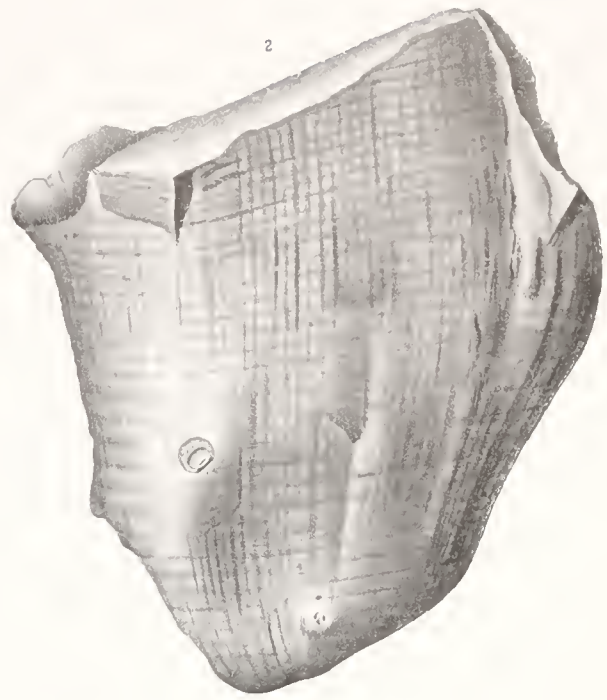
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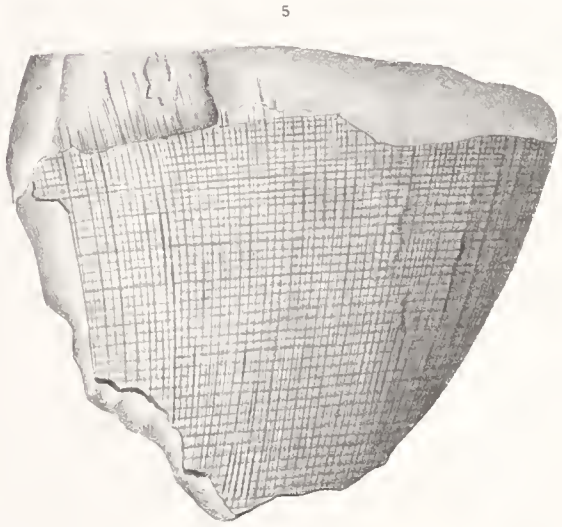
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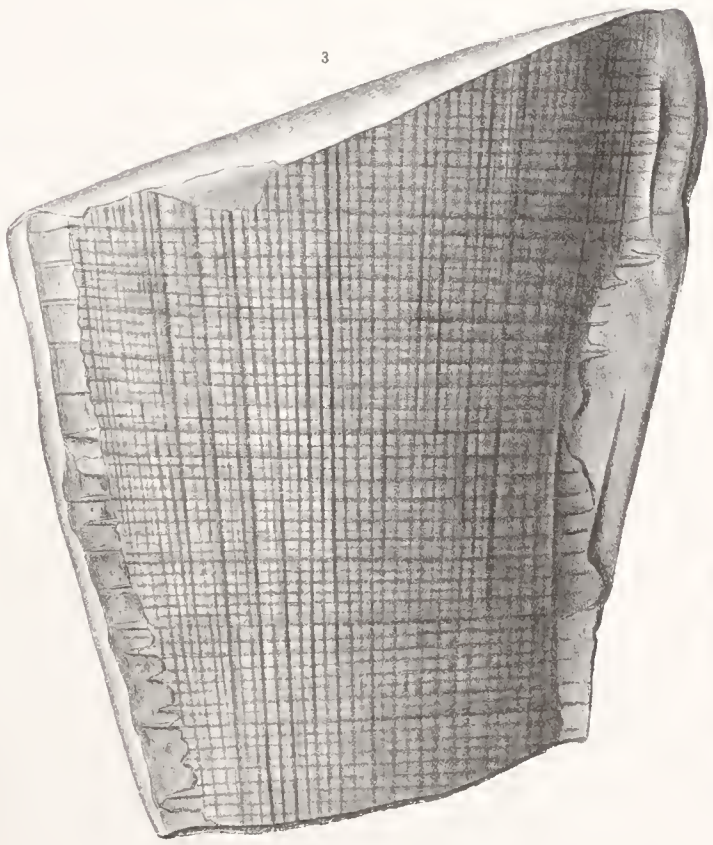
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G.B Simpson del

Philp Ast lith

PHYSOSPONGIA, Hall.

Page 187.

(See Plates LVI, LXII and LXIII.)

PHYSOSPONGIA MULTIBURSARIA, sp. nov.

Page 196.

Figure 7. A portion of a frond which is a flat, undefined expansion showing a finely reticulate surface. The vertical areas lying between the principal spicular bands are more or less completely covered by pendulous, overlapping nodes in the form of internal casts without much evidence of reticulation. No other example of this species has been observed.

Keokuk group. *Crawfordsville, Indiana.*

PLATE LXII.

PHYSOSPONGIA, Hall.

Page 187.

(See Plates LVI, LXI and LXIII.)

PHYSOSPONGIA DAWSONI, Whitfield (sp.).

Page 189.

Figure 1. A portion of a slender cup showing the difference in size of the primary and secondary vertical bundles, the alternation of the nodes and concavities and the projection of a few spicular tufts at the lateral margins.

Figure 2. A nearly entire specimen of average size, abnormal in having one of the primary vertical strands of no larger size than those of the secondary series. The rapid multiplication of the quadrules is observable near the summit of the specimen. Some of the nodes are presented in profile at the sides of the specimen.

Figure 3. The lateral portion of an individual which shows in the matrix the long spicular tufts extending from the intersections of the vertical and horizontal bands.

Figure 4. The median portion of a somewhat worn specimen showing the alternating vertical strands, nodes and concavities.

Figure 5. A very regularly developed, nearly entire cup which retains the fine spicular markings of the quadrules, shows the form of some of the nodes in profile and two projecting spicular tufts.

Figure 6. A specimen which has been somewhat obliquely compressed shows the broad vertical primary spicular bands and the profile of the nodes and spicular tufts.

Figure 7. A larger example, showing an unusual development of the nodes, and the rapid increase of nodes and concavities toward the aperture, by horizontal division.

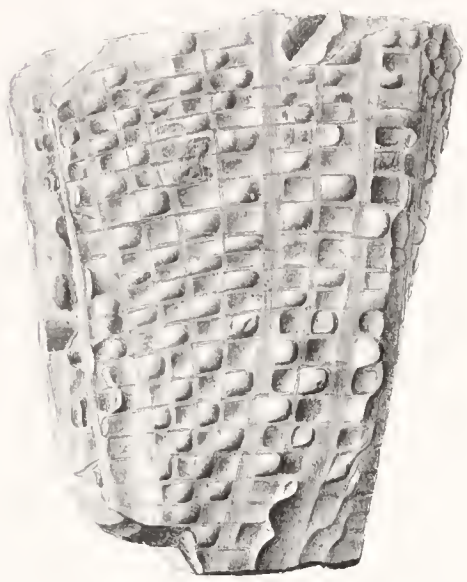
Figure 8. An enlargement of the lateral portion of a frond showing the spicular tufts arising at the intersection of the vertical and horizontal bundles. The specimen also shows, as a discoloration of the matrix, an erect lamellar film connecting the spicular tufts. This has not been observed on other examples. *x*3.

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate LXII

1



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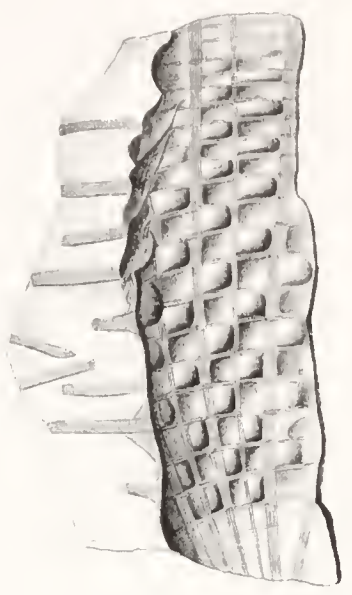

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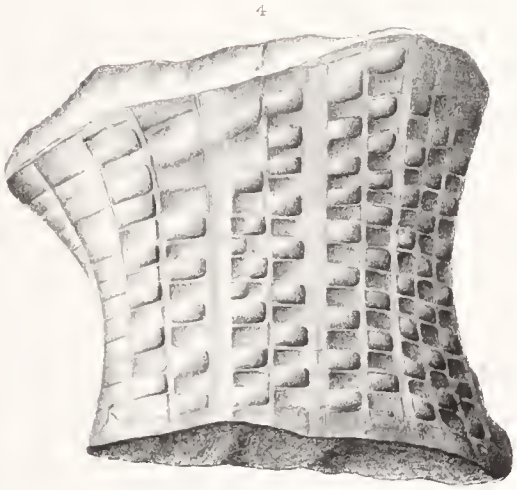

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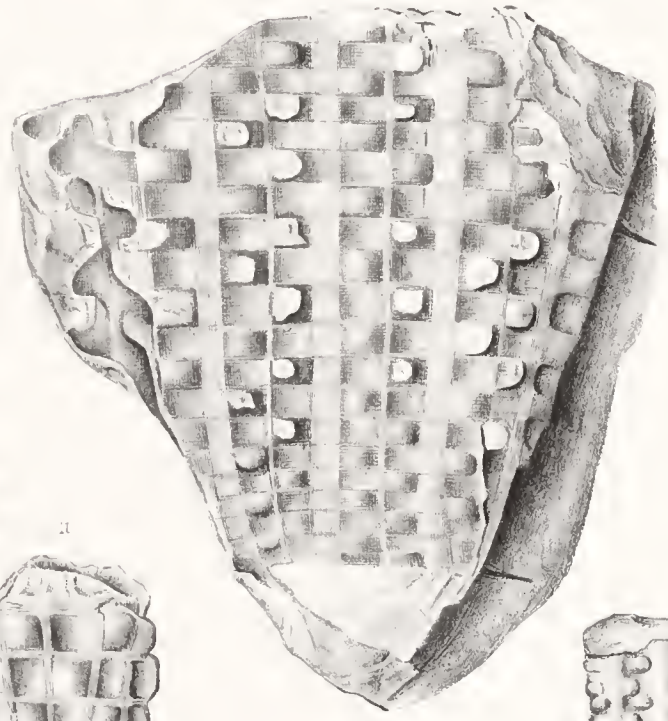

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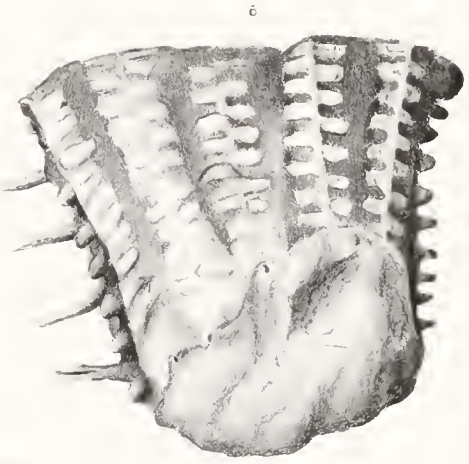

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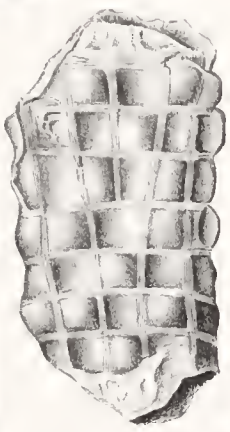

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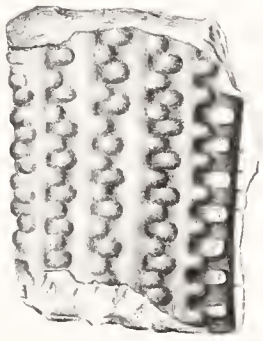

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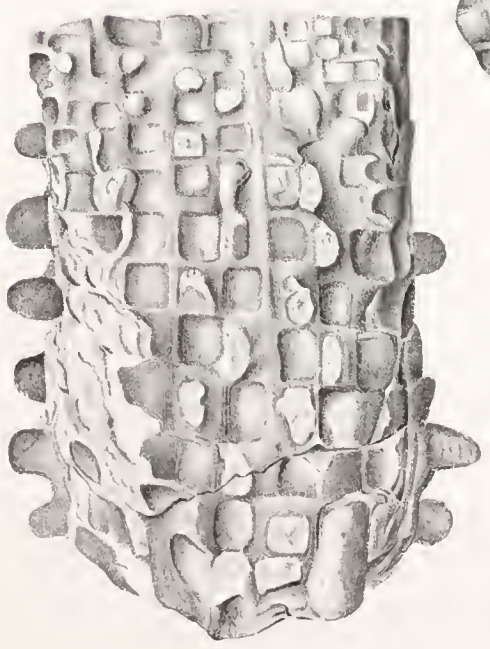

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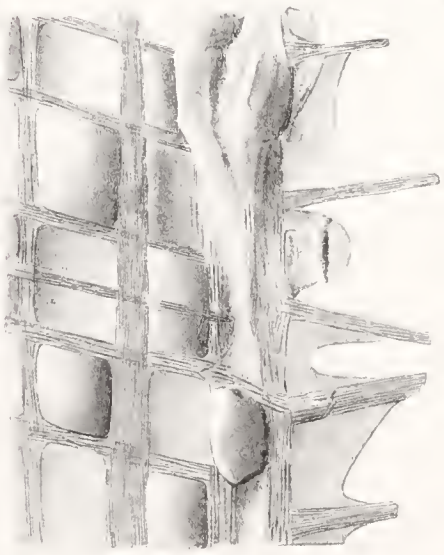

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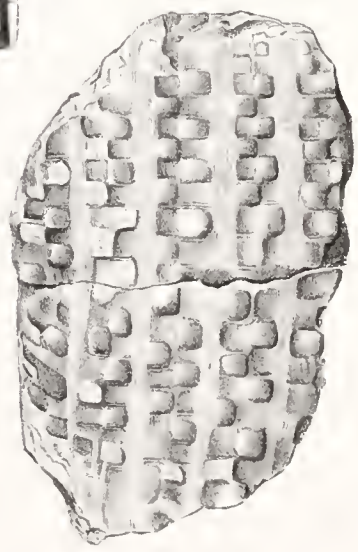

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E Emmons del

Philp Ast lith

Figure 9. An incomplete example of medium size in which the primary vertical bands are broad and the secondary bands exceedingly narrow.

Figure 10. A specimen of small size; showing the regularly alternating arrangement of the nodes.

Keokuk group. *Crawfordsville, Indiana.*

PHYSOSPONGIA ALTERNATA, Hall.

Page 195.

Figure 11. A view of the original specimen; showing the narrow, subcylindrical form with large quadrules and subequal vertical strands. In the latter there is some difference in size although not clearly shown on the somewhat abraded surface here represented.

Keokuk group. *Crawfordsville, Indiana.*

PLATE LXIII.

PHYSOSPONGIA, Hall.

Page 187.

(See Plates LVI, LXI and LXII.)

PHYSOSPONGIA COLLETTI, Hall.

Page 193.

Figure 1. A nearly entire specimen of rather small size showing the usual aspect of the species. The nodes have undoubtedly been somewhat flattened, and the secondary vertical spicular bundles are represented as rather too broad.

Figure 2. An enlargement of a portion of the surface in the same specimen, showing two nodes and their corresponding concavities, each pair being separated by a major vertical spicular band. The surface of the quadrules shows indications of a finer reticulation.

Figure 3. A fragment of a large, somewhat irregular example, showing the obsolescence of the nodes near the aperture.

Figure 4. An enlargement of the surface in the smooth apertural region of the foregoing specimen, showing the diminution in the size of the spicular bundles. x2.

Figure 5. The apertural major portion of a sponge; showing the diffusion of the vertical spicular bands of the first order, and the multiplication of the quadrules by increase in the number of both horizontal and vertical bundles. At the aperture all nodes and depressions have become obsolete.

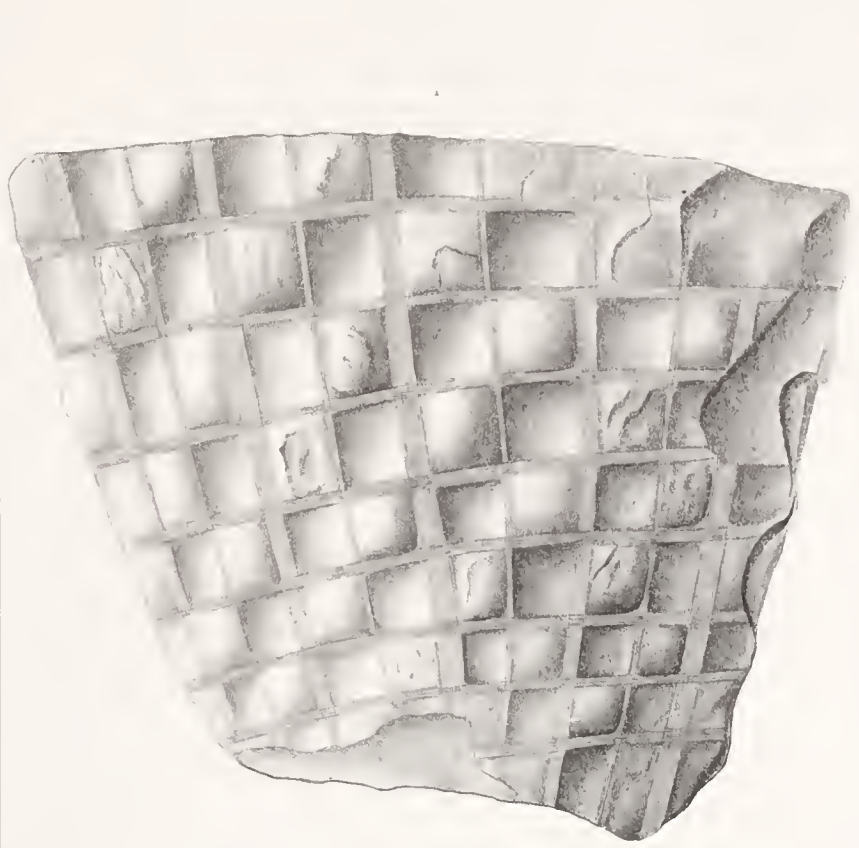
Figure 6. A portion of the same specimen redrawn to show more distinctly the multiplication of the nodes by horizontal and vertical division. Natural size.

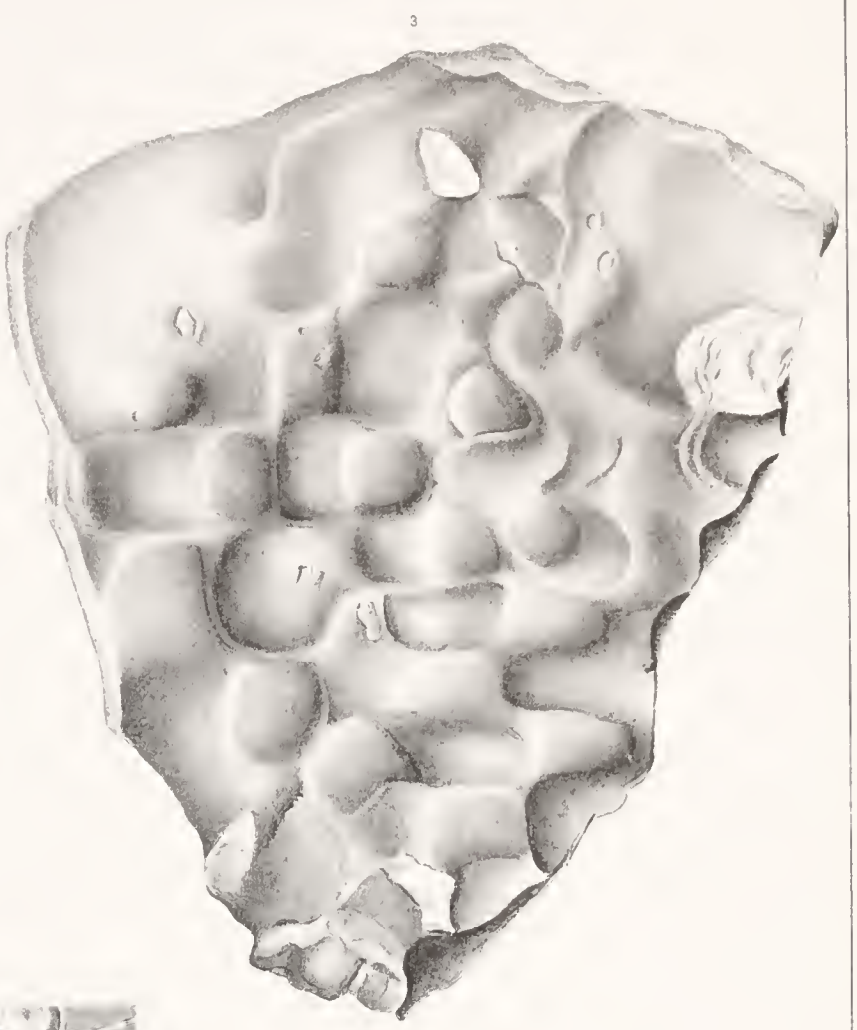
Figure 7. A portion of a very large specimen, natural size, in which the fine reticulation of the quadrules is distinctly retained.
Keokuk group. *Crawfordsville, Indiana.*

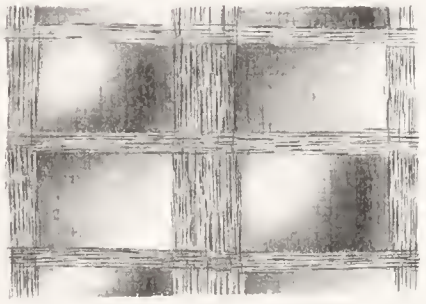
DICTYOSPONGIDÆ.

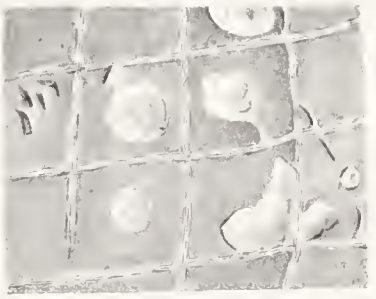
Memoirs Geological Survey of New York

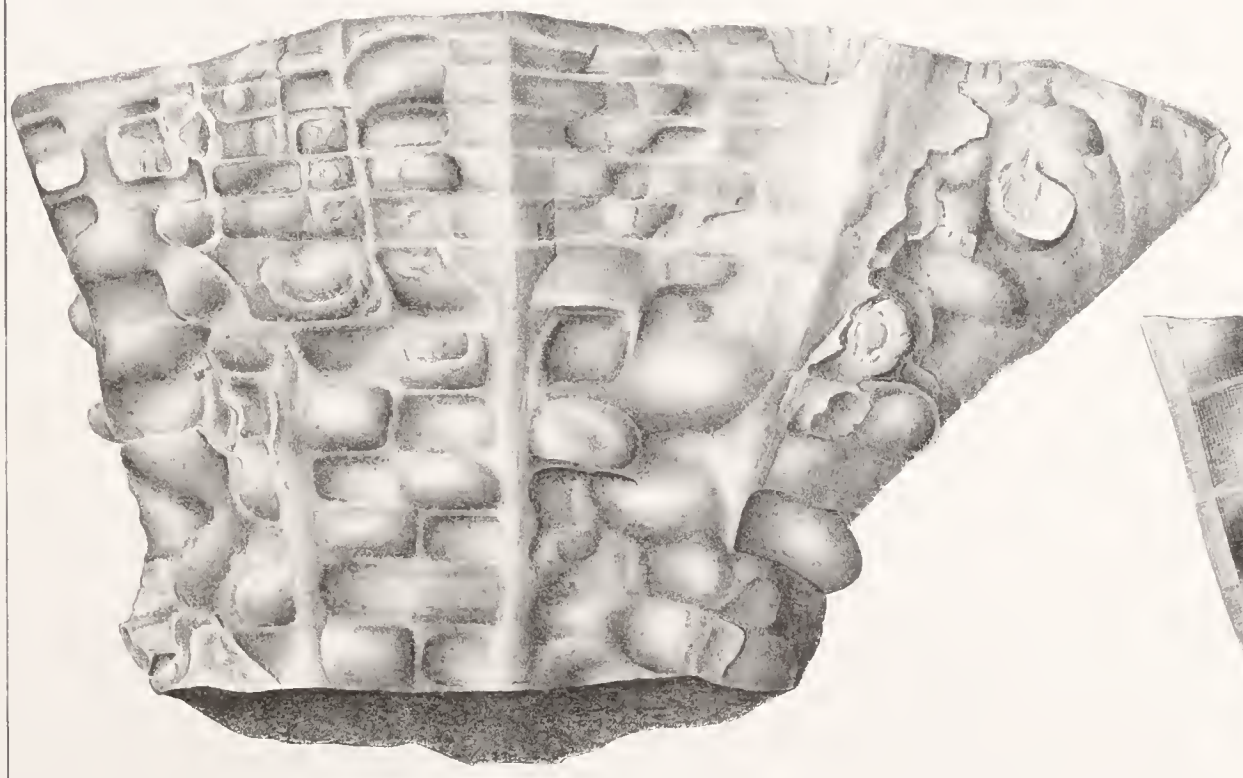
Plate LXIII

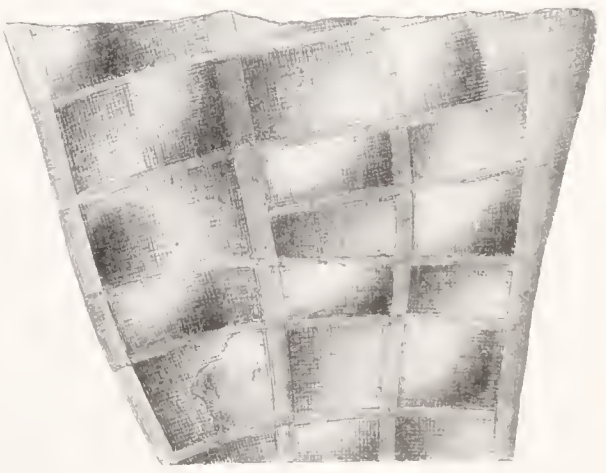












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Philip Ast lith

PLATE LXIV.

PHRAGMODICTYA, Hall.

Page 172.

(See Plates LXV, LXVI, LXVII, LXVIII.)

PHRAGMODICTYA CATILLIFORMIS, Whitfield (sp.).

Page 173.

(See Plates LXV, LXVI, LXVII, LXVIII.)

Figure 1. A small specimen which has been compressed vertically, disturbing the form of the cup but showing the transverse basal plate.

Figure 2. A view of the basal surface of the same specimen; showing the radiating spicular bands.

Figure 3. The basal extremity of a larger example to which the peripheral frill or periloph is attached. This specimen shows the ridged and crenulated surface of the frill, the eccentric apex of the base, and retains a part of the vertical portion of the sponge though in a compressed condition.

Figure 4. An incomplete specimen, showing the approximate outline of the entire sponge. This example has the surface ridges unusually strong and regular and some of them are evidently continued on to the periloph. The edge of the basal plate is very sharply defined.

Figure 5. An imperfect but very large example, exposing the basal area, a portion of the broad periloph and the vertical cup in a compressed condition. The convergence of the radial spicular striae of the base is very clearly defined. This is the original specimen of the species.

Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate LXIV

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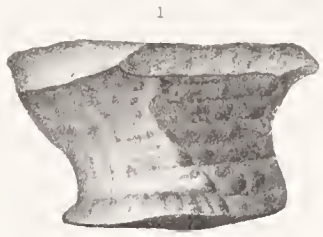
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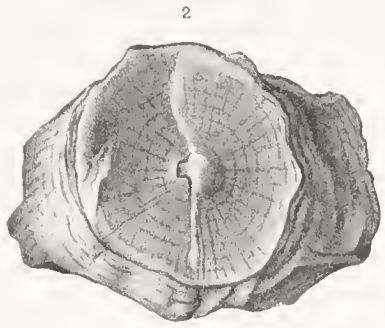
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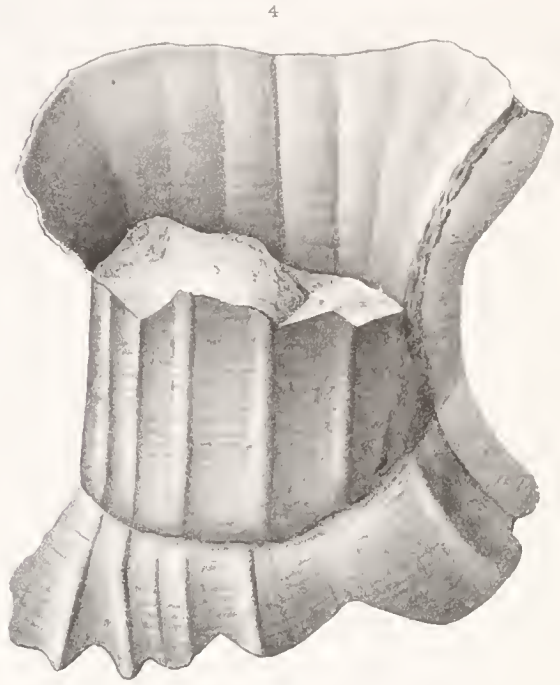
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Philip Ast lith

PLATE LXV.

PHRAGMODICTYA, Hall.

Page 172.

(See Plates LXIV, LXVI, LXVII, LXVIII.)

PHRAGMODICTYA CATILLIFORMIS, Whitfield (sp.).

Page 173.

(See Plates LXIV, LXVI, LXVII, LXVIII.)

Figure 1. The lower side of a large basal disc with the entire periloph retained; showing the fine radial spicular striations of the former and the ridged surface and somewhat irregular margin of the latter

Figure 2. A natural half section of a basal disc with a highly elliptical form, undoubtedly due to lateral compression.

Keokuk group. *Crawfordsville, Indiana.*

PHRAGMODICTYA PATELLIFORMIS, Hall.

Page 176.

Figure 3. The lower surface of a large basal disc with a highly eccentric apex.

Keokuk group. *From the sandy calcareous layers overlying the calcareous shales, at Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

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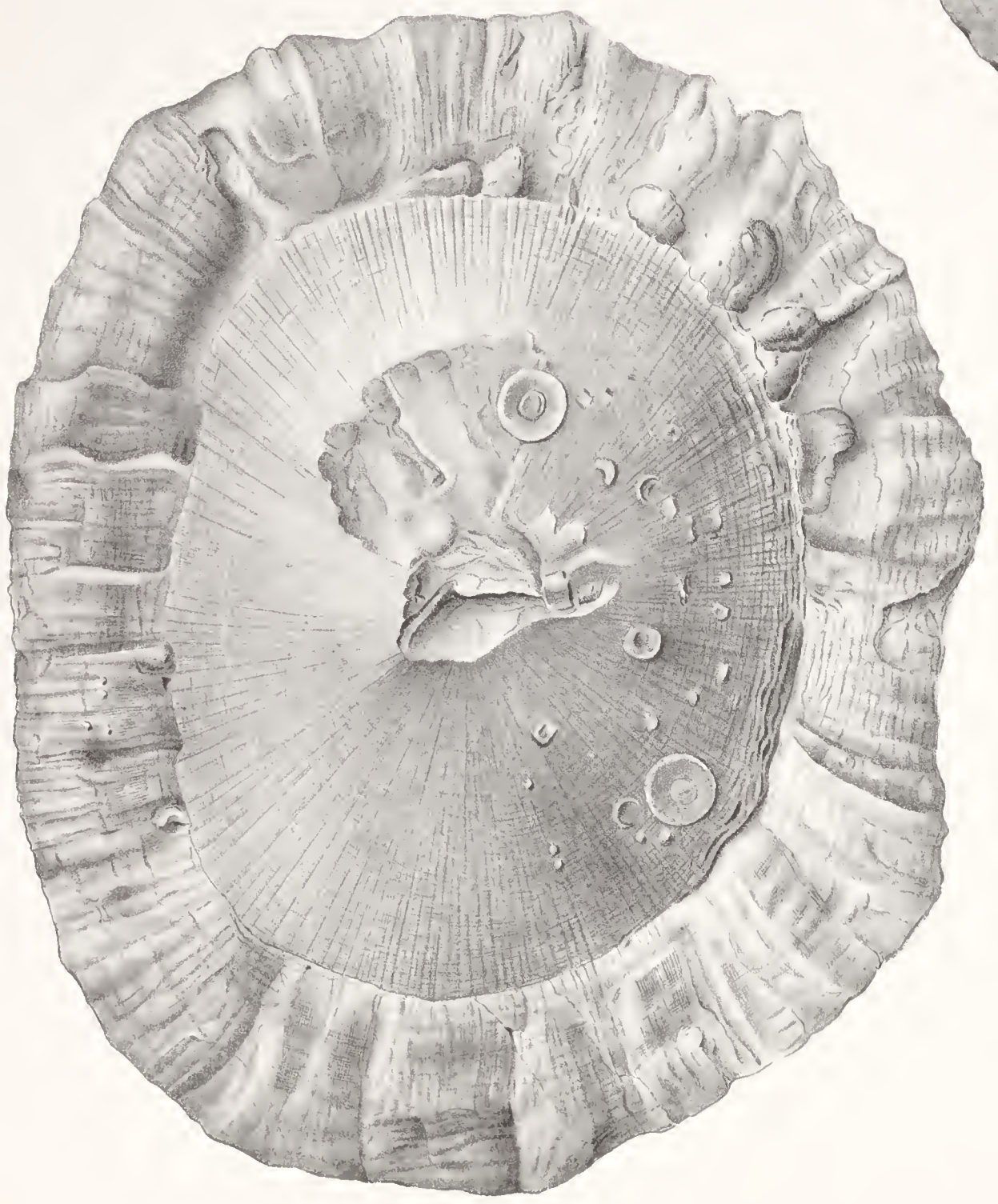

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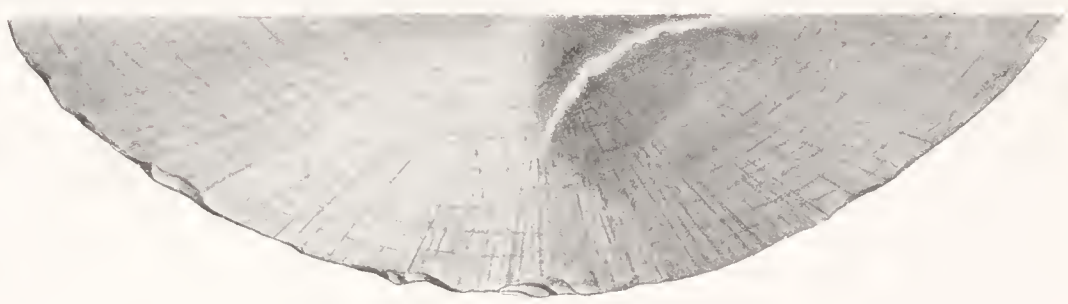

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Philip Ast lith

PLATE LXVI.

PHRAGMODICTYA, Hall.

Page 172.

(See Plates LXIV, LXV, LXVII, LXVIII.)

PHRAGMODICTYA CATILLIFORMIS, Whitfield (sp.).

Page 173.

(See Plates LXIV, LXV, LXVII, LXVIII.)

Figure 1. A small basal disc with sharp and fine radial striæ.

Figure 2. A portion of a large specimen, showing the extremely fine reticulum, the discontinuous vertical ridges and the convexity of the basal disc.

Figure 3. A portion of a very broad periloph, showing the fine net-work, the ridged surface and the irregular free margin.

Figure 4. A part of the reticulum about the apertural margin; showing scattered nodes and nodiform ridges, and a smooth surface at the margin itself.

Figure 5. A small, nearly entire individual, with broadly expanded aperture. This specimen retains the probable outline of the species, except for the obliquity of the lower part of the cup.

Figure 6. The lower portion of an internal cast, showing the convexity of the basal plate and the regular convergence of the vertical striæ.

Figure 7. A small specimen, entire from the basal disc to the aperture; showing the expanding form of the cup.

Figure 8. A specimen of moderately large size, entire except about the aperture, the parts being detached at the basal disc, showing the form and depth of the latter and the length and character of the periloph.

Figure 9. The same specimen with the parts brought together into their normal condition.

Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

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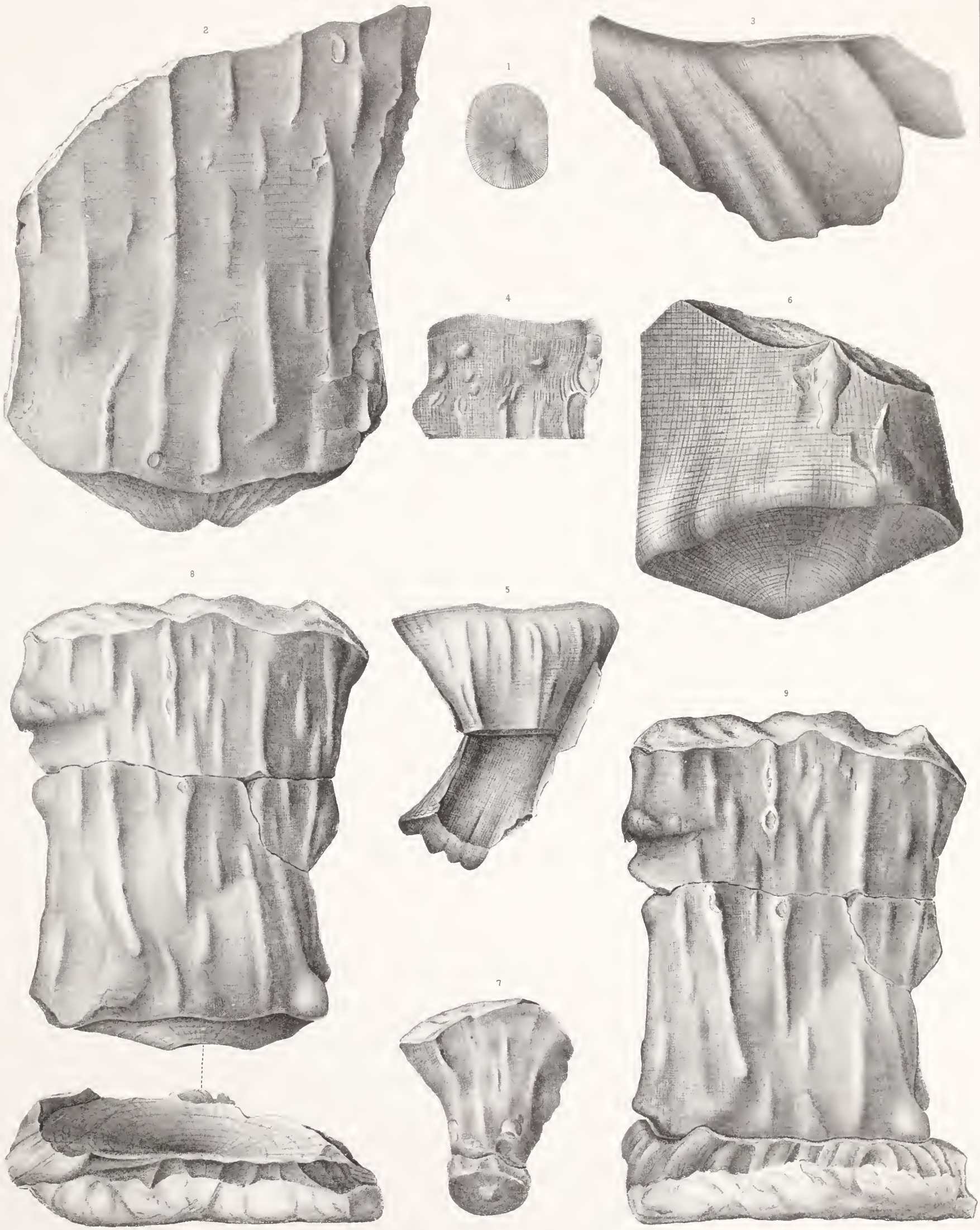
Plate LXVI



G.B Simpson del

Philip Ast lith

PLATE LXVII.

PHRAGMODICTYA, Hall.

Page 172.

(See Plates LXIV, LXV, LXVI, LXVIII.)

PHRAGMODICTYA CATILLIFORMIS, Whitfield (sp.).

Page 173.

(See Plates LXIV, LXV, LXVI, LXVIII.)

Figures 1, 2. Opposite sides of a slender specimen, whose basal disc has an elongate apical scar of attachment.

Figure 3. A characteristic example of average dimensions showing the aperture and basal disc.

Figure 4. The apertural portion of a very large individual, showing the expanded cup, with the vertical ridges and scattered nodes of the surface.

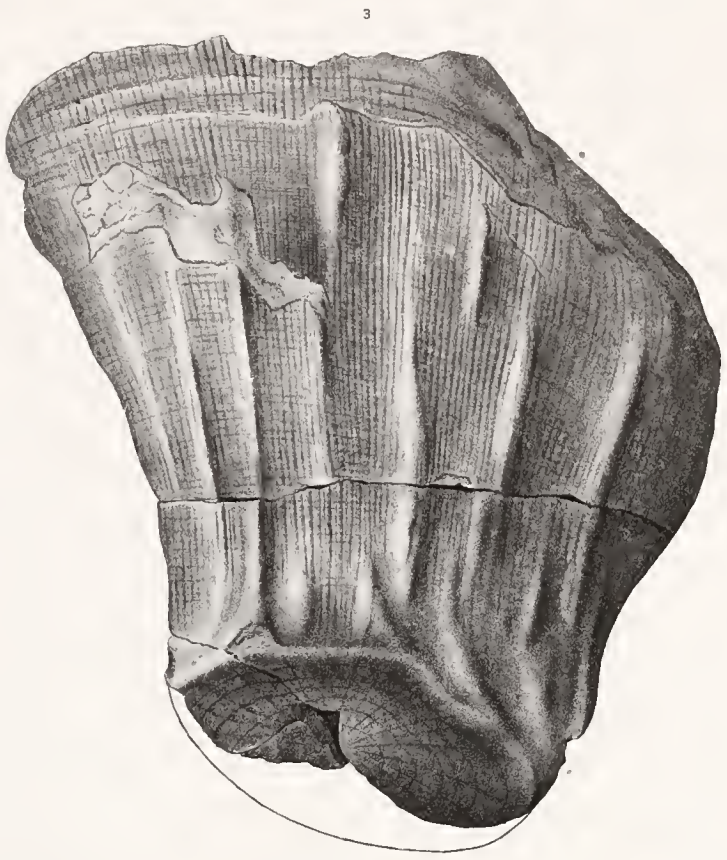
Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate LXVII

1



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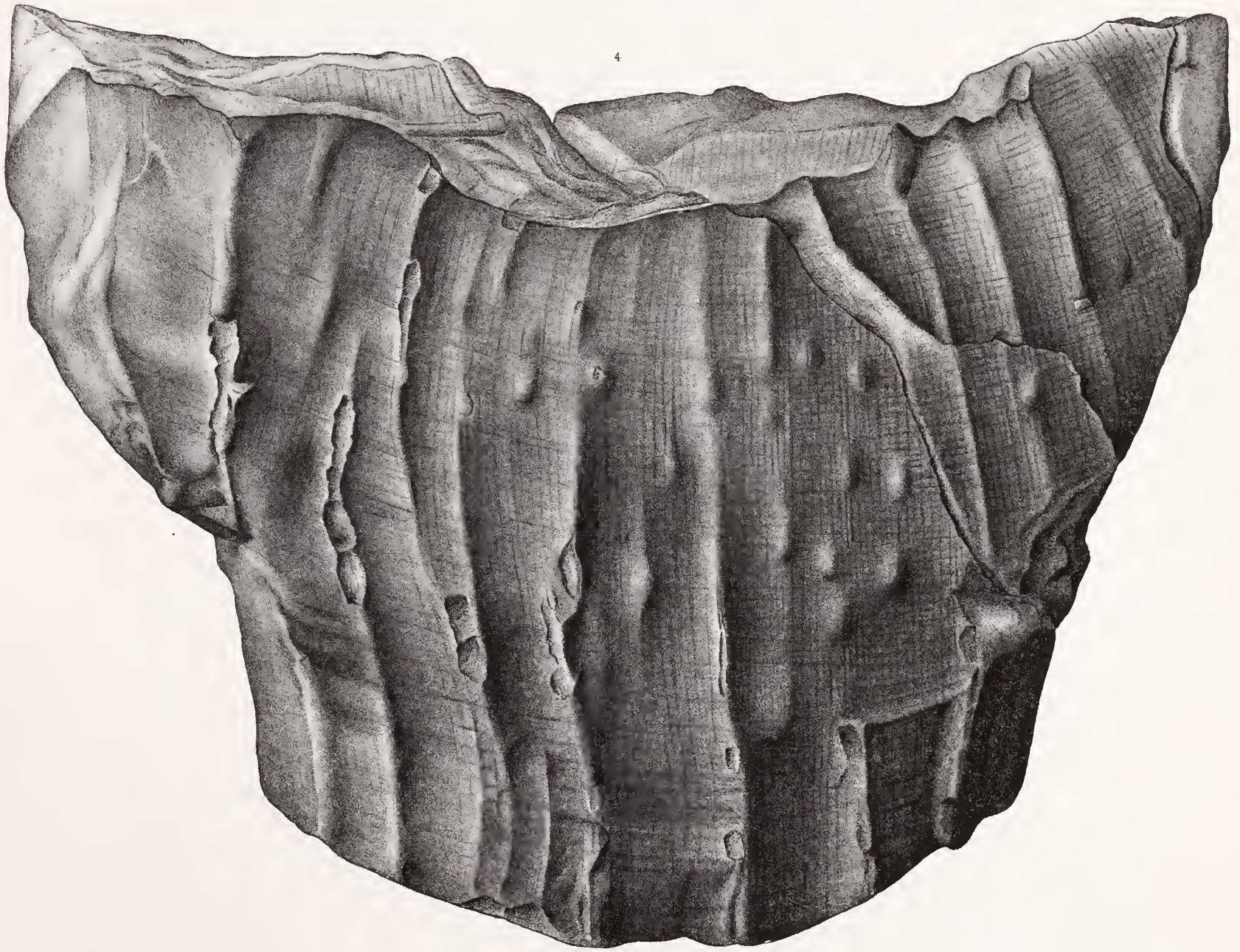

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PLATE LXVIII.

PHRAGMODICTYA, Hall.

Page 172

(See Plates LXIV, LXV, LXVI, LXVII.)

PHRAGMODICTYA CATILLIFORMIS, Whitfield (sp.).

Page 173.

(See Plates LXIV, LXV, LXVI, LXVII.)

Figure 1. An average individual retaining the skeleton from the basal disc upward and preserving the usual configuration of the surface.

Figure 2. A small specimen, exposing the basal disc and part of the periloph.

Figure 3. A portion of a moderately large example showing the disc and the strong vertical surface ridges.

Figure 4. The concave or lower surface of the basal disc with the broad periloph attached.

Keokuk group. *Crawfordsville, Indiana.*

(?) PHRAGMODICTYA LINEATA, Hall.

Page 176.

Figure 5. The original specimen, which is a fragment of a smooth, slender subcylindrical cup, somewhat expanded about the lower end. It is probably not a species of PHRAGMODICTYA.

Keokuk group. *Crawfordsville, Indiana.*

CALATHOSPONGIA, gen. nov.

Page 155.

(See Plates XLVIII, XLIX, L, LI, LII, LVI, LVII, LX.)

CALATHOSPONGIA AMPHORINA, sp. nov.

Page 182.

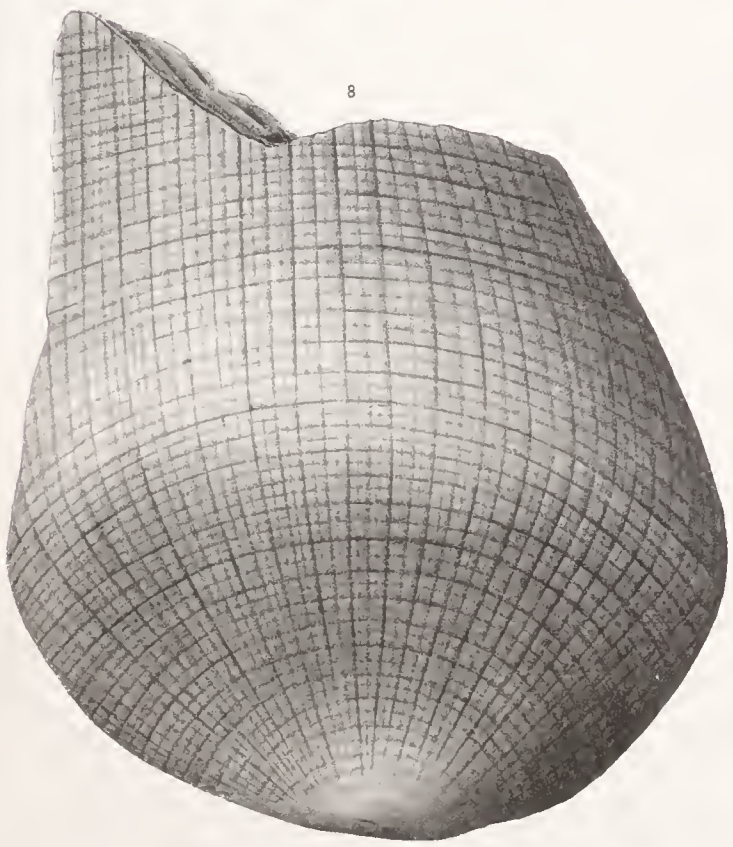
Figure 6. A specimen with the flaring upper portion somewhat deflected but showing the general aspect of the sponge. The surface is smooth and the reticulum fine with prominent vertical spicular bundles.

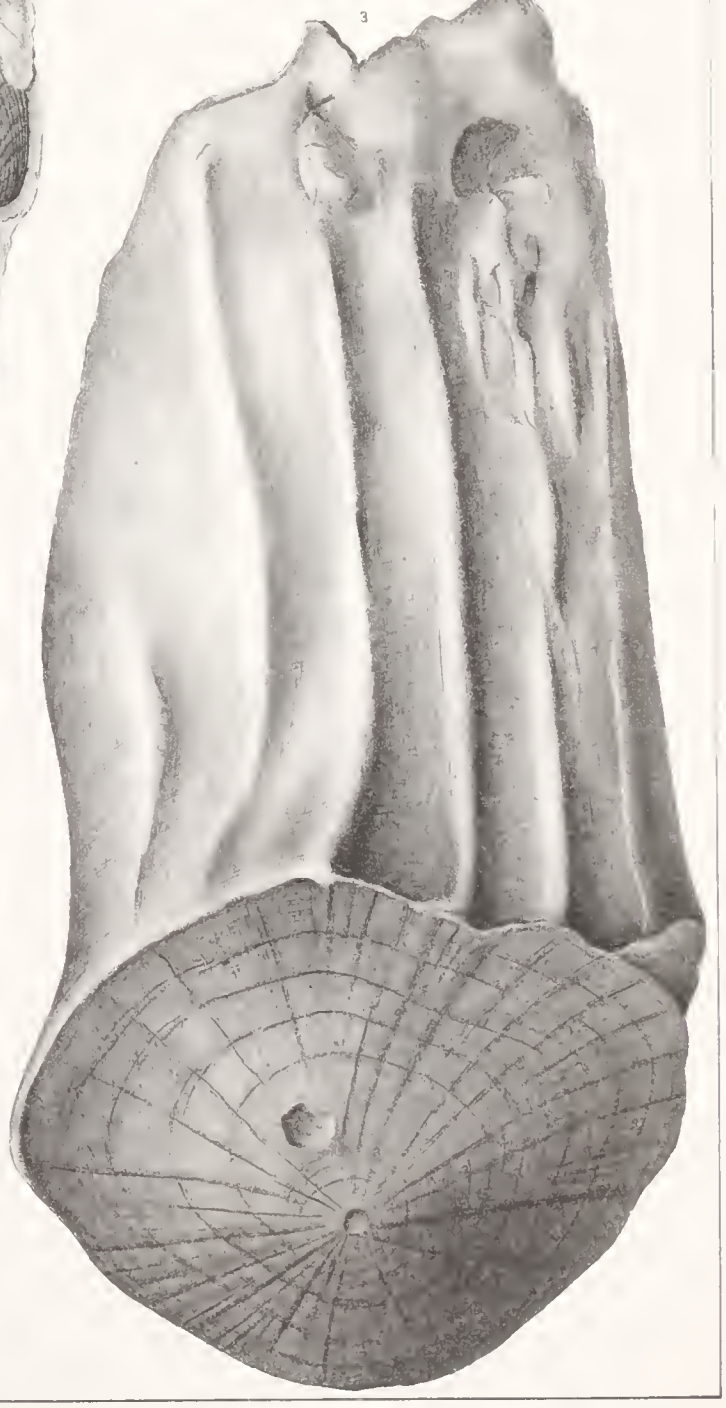
Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate LXVII





G. B Simpson del.

Philip Ast lith

ACLŒODICTYA, gen. nov.

Page 177.

(See Plates LIV, LV, LX, LXI.)

ACLŒODICTYA MARSIPUS, sp. nov.

Page 178.

(See Plates LV, LX, LXI.)

Figures 7, 8. The basal parts of two specimens, showing the character of the reticulum and the broad curvature at the basal edge.
Keokuk group. *Indian Creek, Indiana.*

PLATE LXIX.

CLEODICTYA, Hall.

Page 163.

(See Plates LI and LXX.)

CLEODICTYA GLORIOSA. Hall.

Page 183.

(See Plate LXX.)

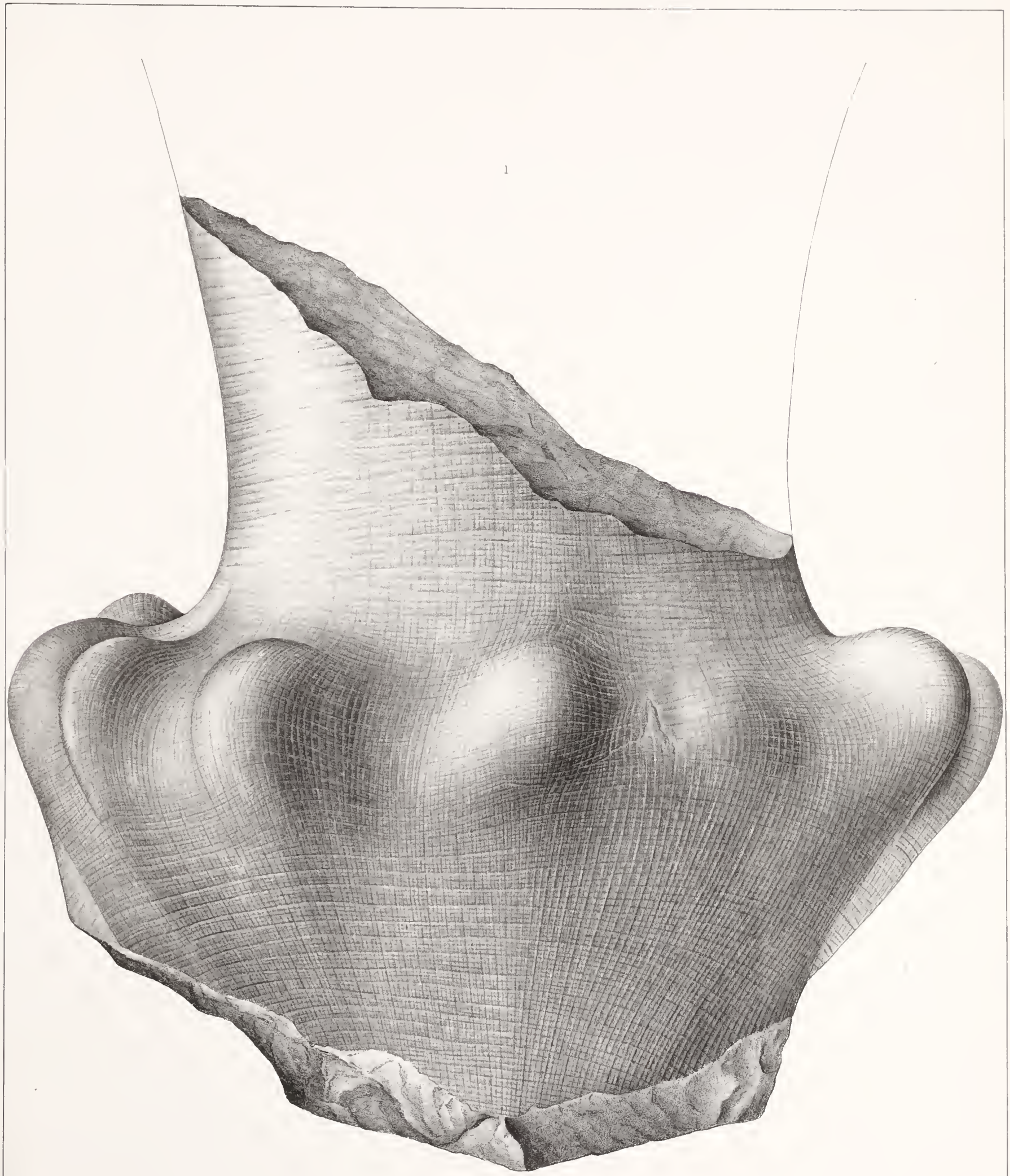
Figure 1. Lateral view of the original specimen which shows the lower expansion with its broad obtuse nodes, and retains a part of the upper vase-shaped extension.

Keokuk group. *From the sandstone overlying the calcareous shales at Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York

Plate LXIX



E Emmons del

Philip Ast lith

PLATE LXX.

CLEODICTYA, Hall.

Page 163.

(See Plates LI and LXIX.)

CLEODICTYA GLORIOSA, Hall.

Page 183.

(See Plate LXIX.)

Figure 1. The specimen figured on the preceding plate, viewed from above; showing the slight lateral compression. The expanded portion bears ten well developed nodes and an eleventh in an incipient state.

Figure 2. Basal view of the inferior nodose expansion of a smaller specimen, bearing twelve nodes, some of them obscurely or incipiently developed.

Keokuk group. *Crawfordsville, Indiana.*

CLEODICTYA MORRI, Hall.

Page 184.

Figure 3. The original specimen, showing the low basal nodiferous expansion, the contraction above and gradual expansion to the aperture. The spicular skeleton in this specimen is largely pyritized.

Keokuk group. *Crawfordsville, Indiana.*

DICTYOSPONGIDÆ.

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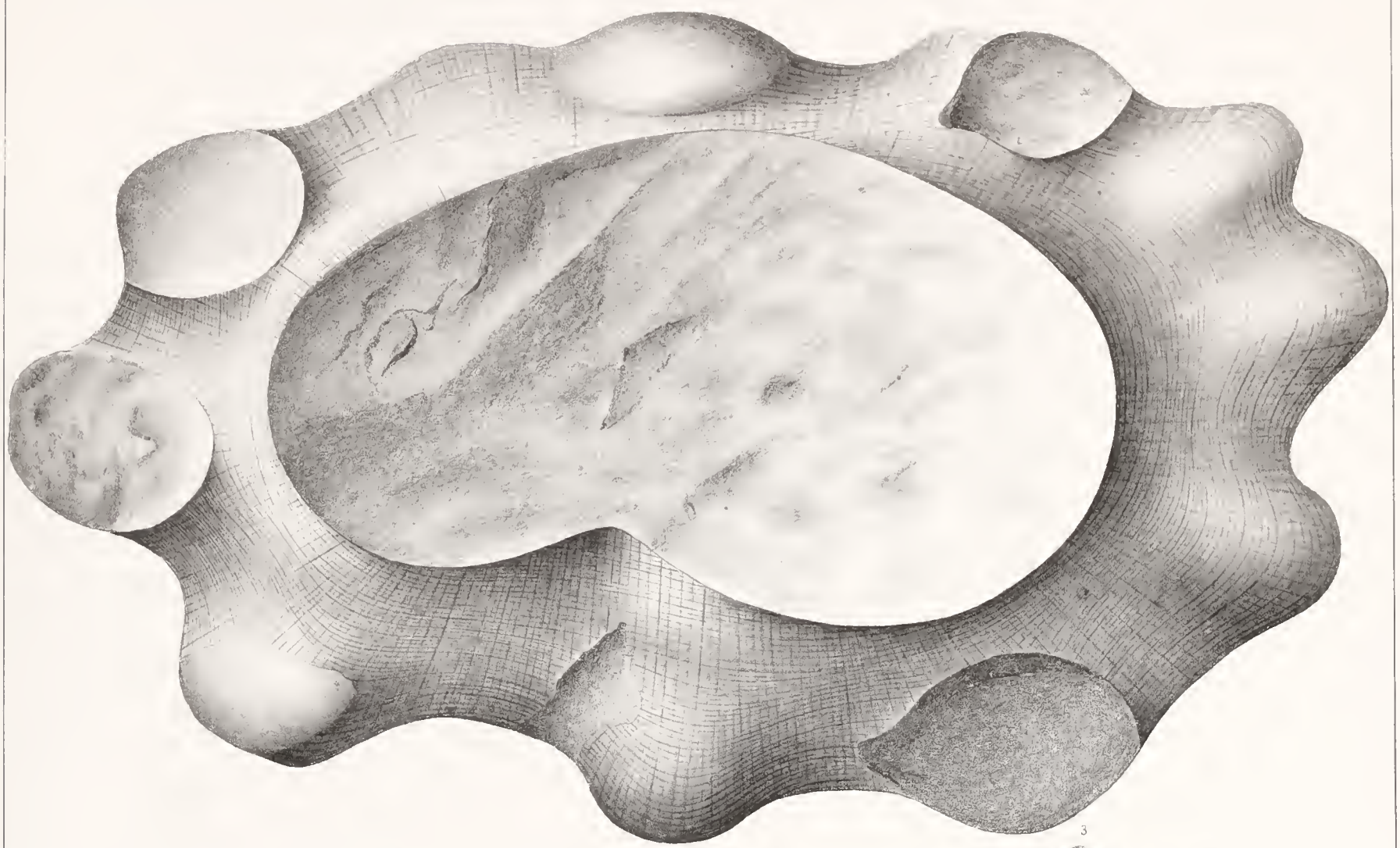

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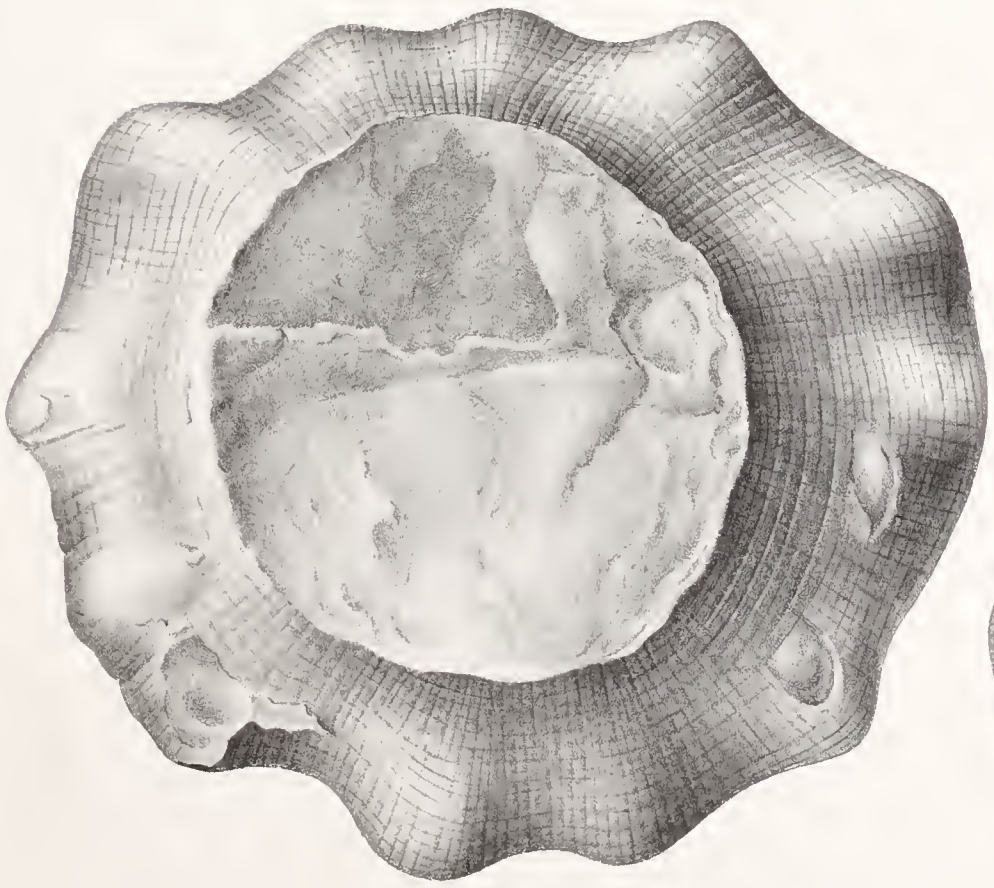

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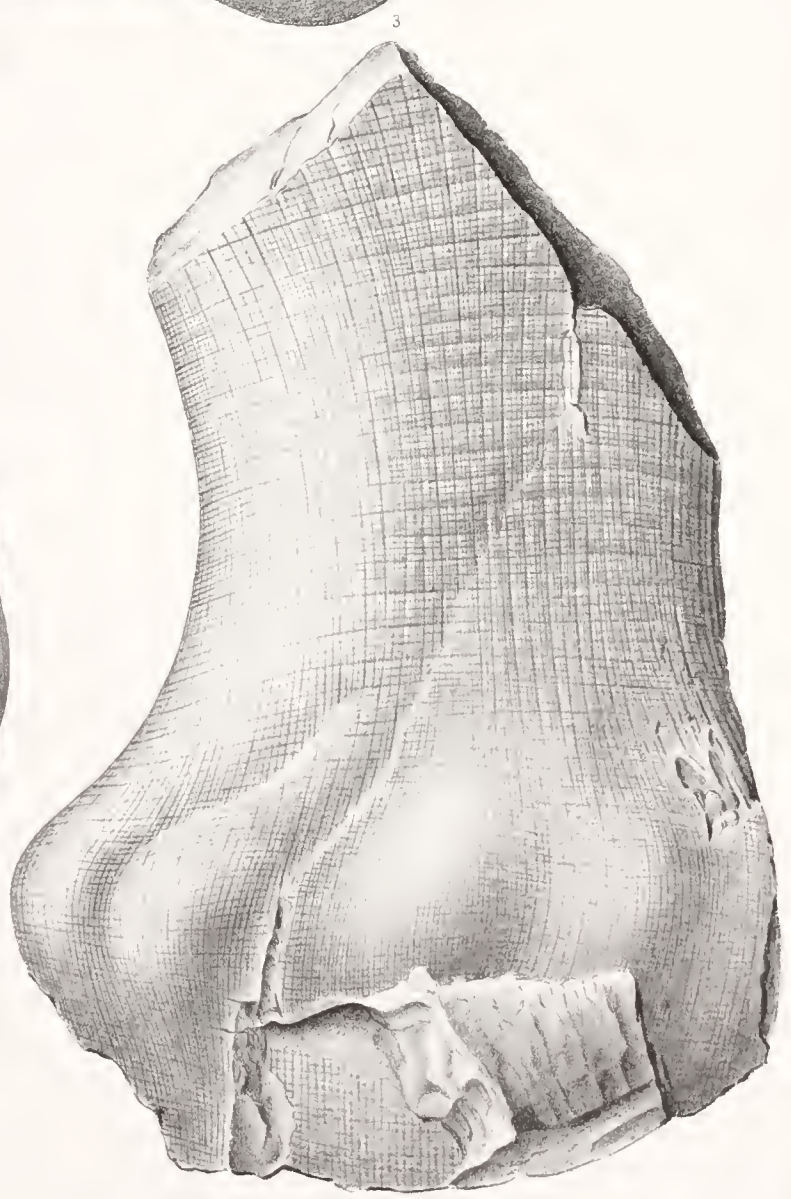

INDEXES

To Personal Names, Localities, Families, Genera and Species.

INDEX

To Personal Names.

Allen, J., 5, 105, 145.
Ast, Ph., 6.
Barrois, C., 5, 45, 72, 95, 97, 100, 101, 147, 148, 290, 292.
Beecher, C. E., 6, 48, 96, 152.
Carll, J. F., 5, 158.
Carpenter, F. H., 117.
Clarke, J. M., 4, 6, 7, 51, 65, 166, 168, 170, 171, 174, 175, 177, 178, 180, 184, 185, 186, 190, 191, 192, 194, 196, 280.
Claypole, E. W., 6, 163.
Cole, F., 118.
Conrad, T. A., 3, 13, 41, 42, 95, 96, 97, 101, 161, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 264, 270, 272, 274, 276, 290.
Cotton, Thomas, 100, 103, 104, 106.
Dawson, J. W., 5, 23, 24, 25, 42, 44, 47, 48, 187.
Doederlein, 22.
Eichwald, 72.
Emmons, E., 6.
Frech, F., 51.
Girty, G. H., 51, 64.
Goode, G. B., 6.
Gray, 20, 21.
Haeckel, E., 15.
Hall, E. B., 4, 74, 75, 77, 79, 82, 83, 85, 86, 87, 88, 89, 90, 92, 108, 110, 114, 115, 116, 117, 118, 127, 128, 130, 131, 132, 134, 136, 137, 140, 141, 184.
Hall, James, 7, 42, 43, 44, 45, 46, 47, 49, 66, 72, 73, 77, 78, 79, 80, 81, 82, 83, 86, 91, 95, 96, 97, 109, 112, 116, 118, 119, 120, 121, 122, 123, 124, 125, 126, 128, 129, 137, 139, 142, 143, 144, 152, 153, 154, 155, 157, 160, 161, 163, 164, 165, 166, 170, 172, 173, 176, 177, 179, 183, 184, 187, 189, 193, 195, 202, 206, 226, 228, 230, 232, 234, 236, 237, 238, 240, 241, 242, 244, 246, 248, 252, 258, 260, 262, 268, 271, 282, 294, 296, 298, 300, 302, 304, 305, 306, 308, 310, 320, 321, 322, 323, 324, 326, 328, 330, 332, 334, 336, 338.
Hinde, G. J., 22, 23, 45, 47, 48, 63, 64, 72, 95, 97.
Hyatt, A., 26.
Johnston, J. S., 131.
Kemp, J. F., 6.
Larkin, E. P., 42, 95.
Lesley, J. P., 83, 111, 139, 155.
Lesquereux, L., 46, 111, 224.
Luther, D. D., 5, 68, 69, 70, 71, 72, 100, 105, 107, 109, 143.
Marsh, O. C., 92.
McCoy, F., 41, 45, 63, 64, 72.
McKee, J. H., 6.
Morris, 41.
Murchison, R. I., 41.
Neumayr, M., 48, 96.
Newberry, J. S., 3, 6.
Orton, E., 162.
Owen, R., 14, 28.
Rauff, H., 15, 20, 21, 22, 23, 24, 25, 26, 27, 33, 34, 49, 50, 126, 127, 201.
Redfield, W. C., 156.
Riley, A. H., 117
Roemer, F., 43, 45, 51, 63, 67, 72, 95, 97, 189.
Roth, J., 143.
Russell, I. C., 6.
Salter, J. W., 41.
Schimper, W., 43, 95.
Schlueter, C., 49, 68.
Schmidt, O., 21.
Schuchert, C., 6, 26, 49.
Schulze, F. E., 15, 18, 21, 28, 33, 40, 47, 142, 170, 187.
Sherwood, A. S., 112, 143,
Simonds, F. W., 125.
Simpson, G. B., 6.
Thomson, W., 14, 21, 22.
Tiffany, A. S., 5, 157, 160, 170, 179.
Ulrich, E. O., 48.
Van Deloo, J., 6, 142, 143.
Vanuxem, L., 3, 13, 41, 42, 137, 139, 254, 256, 288.
Walcott, C. D., 24, 25, 26, 200.
Ward, H., 44.
Whitfield, R. P., 3, 6, 43, 44, 46, 95, 166, 172, 173, 187, 189, 191, 308, 320, 326, 328, 330, 332, 334.
Winchell, N. H., 49.
Wright, A. A., 6.
Zittel, K. von, 36, 45, 51, 95, 96, 146.

INDEX

To Localities.

Addison, N Y., 41, 206.

Akron, O., 156, 163, 294, 300.

Alfred, N. Y., 5, 42, 73, 111, 123, 124, 125, 135, 145, 222, 234, 241, 248, 250, 253.

Alma, N. Y., 86, 129, 244.

Almond, N. Y., 76, 77, 85, 236, 286.

Andover, N. Y., 73.

Avoca, N. Y., 38, 70, 76, 100, 101, 103, 104, 106, 137, 142, 145, 202, 214, 216, 218, 220, 276, 281, 282, 283.

Bath, N. Y., 38, 40, 101, 102, 103, 104, 202, 204, 210, 214, 216.

Benson, England, 65.

Brigsteer, England, 64.

Brittany, France, 147, 148, 149, 150.

Brown Hill, N. Y., 38, 45, 78, 99, 101, 108, 143, 202, 204, 206, 208, 210, 212, 214, 258, 260, 272, 274.

Burlington, Iowa, 166, 305.

Canandaigua lake, N. Y., 67, 226.

Cassadaga creek, N. Y., 127.

Charleston, Pa., 112.

Chemung narrows, N. Y., 123, 129, 226, 248.

Cohocton, N. Y., 38, 40, 44, 45, 78, 202, 208, 210, 214, 249, 258, 260, 272, 274.

Concord station, Pa., 84, 116, 240, 252.

Condroz, France, 147, 148, 149, 150.

Cotton hill, N. Y., 38, 70, 76, 106, 137, 142, 214, 276, 281, 282, 283.

Crawfordsville, Ind., 3, 5, 13, 29, 44, 166, 167, 168, 169, 170, 172, 175, 176, 177, 179, 181, 182, 183, 184, 187, 189, 193, 195, 197, 306, 308, 309, 310, 311, 312, 314, 316, 318, 320, 321, 323, 324, 326, 328, 330, 332, 334, 336, 338.

Cuba, N. Y., 38, 39, 73.

Cuyahoga Falls, O., 162, 298.

Deyo basin, N. Y., 40, 79, 109, 120, 208, 230, 242, 270, 272, 309.

Eifel, Germany, 67.

Erie, Pa., 119, 242, 280.

Friendship, N. Y., 73, 81, 88, 226, 228, 230, 268, 270.

Gemünden, Germany, 49.

Gerolstein, Germany, 43, 45, 68.

Gotland, 72.

Great Bend, Pa., 117, 230.

Hamlin's Farm, Naples, N. Y., 38, 40.

Harrisville, Ohio, 156, 296.

Hill creek, Pa., 112.

Hinsdale, N. Y., 83, 129, 134, 135, 268, 276, 278.

Holland Patent, N. Y., 24, 50, 200, 201.

Howard, N. Y., 101, 256.

Indian Creek, Indiana, 29, 157, 179, 193, 318, 335.

Irish hill, N. Y., 38, 103, 202.

Ischua, N. Y., 85, 118, 121, 127, 129, 135, 236, 244, 253, 271, 274, 280, 282, 284.

Italy, N. Y., 101, 107, 215, 272, 282.

Italy hollow, N. Y., 105.

Ithaca, N. Y., 125, 228.

Jamestown, N. Y., 73.

Jenks quarry, N. Y., 101, 102, 103, 104, 202, 204, 214, 216.

Jeumont, France, 45, 147, 148, 149, 150, 290, 292.

Kendal, England, 64.

Kenwood, N. Y., 46.

Lawrenceville, Pa., 114, 143, 146, 224.

Little Genesee, N. Y., 129, 244.

Little Metis, Canada, 23, 24, 25, 47, 48.

Livonia, N. Y., 51, 65, 66, 280.

Lyndon, N. Y., 145, 260, 262.

Mansfield, Pa., 40.

Montrose, Pa., 117.

Moot's run, Ohio, 162, 304.

Naples, N. Y., 38, 40, 68, 69, 70, 72, 79, 100, 101, 109, 120, 208, 264, 266, 309.

Nile, N. Y., 73, 135.
Oil City, Pa., 165, 306.
Oil creek, Pa., 158.
Olean, N. Y., 73, 83, 84, 85, 127, 129, 132, 135, 268, 283.
Owego, N. Y., 140, 254, 256.
Pine Creek, Pa., 158.
Pleasantville, Pa., 156, 158, 302.
Portsmouth, Ohio, 154, 298.
Potter hill, N. Y., 101.
Randolph, N. Y., 92, 118, 234, 236, 284.
Richfield, Ohio, 156, 157, 160, 162, 296, 298, 300, 302.
Scio, N. Y., 73, 85, 87, 88, 89, 90, 110, 114, 116 125, 127, 128, 135, 141, 210, 232, 238, 240, 246 252, 265, 266, 268, 270, 271.
Segur's gully, N. Y., 215.
Underbarrow, England, 64.
Union, N. Y., 288.
Varysburg, N. Y., 70, 71, 106, 264, 265.
Wallace, N. Y., 99, 108.
Warren, Pa., 84, 130, 151, 152, 153, 155, 158, 159, 165, 246, 296, 304, 306.
Wellsville, N. Y., 4, 38, 73, 74, 75, 79, 81, 82, 83, 84, 87, 88, 89, 92, 110, 111, 115, 117, 127, 129, 130, 131, 132, 135, 136, 140, 203, 214, 226, 228, 232, 233, 234, 237, 238, 239, 240, 242, 244, 246, 252, 253, 280, 282.
Westmoreland, England, 41, 64, 72.
Weston Mills, N. Y., 132, 274.
Whitesville, N. Y., 130, 248.

INDEX

To Families, Genera, Etc.

Numbers in black type indicate place of description.

Aclœodictya, *H. and C.*, 164, 172, **177**, 306, 308, 318, 320, 335.

Actinodictya, *Hall*, 17, 49, 141, **142**, 143, 144, 258, 260.

Aglithodictya, *H. and C.*, **145**, 146, 249.

Aglithodictyinæ, *H. and C.*, 53, 56.

Arystidictya, *H. and C.*, **136**, 281, 283.

Asconematidæ, 50.

Astylospongia, *Roemer*, 15.

Botryodictya, *H. and C.*, 33, 95, **111**, 114, 148, 151, 196, 224.

Brachiospongidæ, 48, 50.

Calathospongia, *H. and C.*, 35, 36, 151, **152**, **155**, 160, 182, 184, 294, 296, 300, 302, 311, 312, 318, 334.

Calathospongiinæ, *H. and C.*, 53, 56.

Ceratodictya, *H. and C.*, 17, 35, 40, **117**, 242, 280, 282, 284.

Clathrospongia, *Hall*, 19, 31, 66, 98, **121**, 125, 153, 170, 177, 226, 228, 234, 241, 248, 296, 298.

Cleodictya, *Hall*, 32, 35, 36, 46, **163**, 166, 175, 178, 183, 300, 336, 338.

Clepsydrospongia, *H. and C.*, **71**, 266.

Corynella, 45.

Cryptodictya, *Hall*, **17**, 49, 141, **144**, 260, 262.

Cyathodictya, *H. and C.*, 24, 35, 200.

Cyathophycus, Walcott, 23, 24, 47, 48, 50.

Diagonella, *Dawson*, 23.

Dictyonina, 21, 22.

Dictyophyton, Hall, 13, 24, 42, 43, 45, 46, 47, 48, 72, 77, 79, 95, 96, 155, 160, 161.

Dictyophytra, *Rauff*, 50.

Dictyospongia, *H. and C.*, 17, 35, 36, 63, 65, 68, **72**, 76, 77, **147**, 166, 226, 228, 230, 252, 253, 264, 271, 275, 280, 282, 286, 290, 308, 310, 320.

Dictyospongidæ, *Hall*, 3, 4, 5, 7, 14, 18, 19, 21, 22, 23, 28, **29**, 32, 33, 45, 46, 47, 48, 49, 50, 54, 147, 190.

Dictyospongiinæ, *H. and C.*, 52, 54.

(?) Ectenodictya, *Hall*, 46, **164**, 177.

Ectenodictya, Hall, 177.

Euplectella, *Owen*, 17, 20, 21, 22, 24, 25, 27, 28, 29, 40, 43, 45, 134.

Euplectellidæ, 19, 25, 40, 47, 50.

Gongylospongia, *H. and C.*, **92**, 95.

Griphodictya, *H. and C.*, 32, **179**, 309.

Hallodictya, *H. and C.*, **17**, **140**, 141, 144, 271, 281.

Hallodictyinæ, *H. and C.*, 53, 56.

Helicodictya, *H. and C.*, **114**, 242, 252.

Hexactinellida, 21, 54, 170, 187.

Hindia, *Duncan*, 15.

Holascus, *Schulze*, 17.

Hyalonema, *Gray*, 17, 21, 22.

Hyalonematidæ, 50.

Hydnoceras, *Conrad*, 3, 19, 27, 32, 40, 41, 47, 48, 63, 69, 71, **95**, 96, 97, 108, 110, 111, 112, 113, 141, 151, 154, 161, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 264, 270, 272, 274, 276, 290.

Hydriodictya, *H. and C.*, 40, **77**, 206, 208, 230, 241, 309.

Hyphantænla, *Vanuxem (emend.)*, 19, 26, **137**, 139, 188, 254, 256, 288.

Hyphantæniinæ, *H. and C.*, 53, 56.

Lebedictya, *H. and C.*, 32, 36, 99, 136, **169**, 314, 316, 320.

Lyrodictya, *Hall*, 31, 36, 46, 164, 165, 166, **170**, 175, 305, 308, 310.

Lysactinella, *Girty*, 51, **64**.

Lyssacina, 21, 22, 54.

Mastodictya, *H. and C.*, **167**, 310.

Monactinellida, 21.

Oncosella, *Rauff*, 126.

Pachytrichisma, 146.

Pheronema, *Leidy*, 17.

Phormosella, *Hinde*, 23, 47, 50.
Phragmodictya, *Hall*, 17, 28, 32, 35, 46, 71, 125, 136, 164, **172**, 177, 180, 320, 326, 328, 330, 332, 334.
Phragmodictya ?, 155.
Phragmodictya, 160, 177, 181.
Phragmodictyum, Hall, 45.
Physospongia, *Hall*, 19, 25, 27, 30, 31, 32, 35, 46, 68, 139, 172, 175, 178, **187**, 188, 189, 195, 196, 197, 310, 321, 322, 324.
Physospongiinæ, *H. and C.*, 53, 56.
Plectoderma, *Hinde*, 23, 47, 50.
Plectodermatidæ, *nom. propos.*, 36.
Plectospongidæ, *Hinde*, 23, 25, 36, 50, 51.
Polylophus, *Schulze*, 17.
Prismodictya, *H. and C.*, 19, 35, 36, 63, 69, **79**, 92, 110, 114, 168, 232, 234, 236, 238, 240, 252, 253, 264, 266, 268, 270, 280, 282, 308.
Protospongia, *Salter*, 13, 23, 45, 47, 49.
Protospongidæ, 22, 23, 36, 47, 50, 51.
Rhabdosispongia, *H. and C.*, 35, **116**, 149, 230, 292.
Rhombodictyon, *Whitfield*, 46.
Rœmerispongia, *H. and C.*, 19 46, **67**, 68, 189.
Rossellidæ, 50.
Silicea, 20, 54, 144.
Sphærodictya, *H. and C.*, **26**, 200.
Staurodermidæ, 22, 45.
Stellispongia, 45.
Teganium, *Rauff*, 24, 50, 201.
Tetractinellida, 21.
Tetragonis, McCoy, 43, 45, 48, 72.
Thamnodictya, *Hall*, 35, 46, **160**, 161, 162, 298, 302, 304.
Thysanodictya, *H. and C.*, 17, 19, 28, 36, 63, 71, 121, **125**, 126, 136, 154, 157, 164, 172, 173, 177, 237, 244, 246, 248, 250, 253, 274, 276, 278, 283.
Thysanodictyinæ, *H. and C.*, 52, 56.
Tylodictya, *H. and C.*, 95, 114, **151**, 153, 304.
Uphantænia, Vanuxem, 3, 26, 43, 137, 187.
Ventriculitidæ, 146.
Verticillites, 45.
Walteria, *Schulze*, **143**.

INDEX

To Species.

Numbers in black type indicate place of description.

Aclœodictya (?) eccentrica, *Hall* (sp.), **179,** 306.

A. marsipus, *H. and C.*, 31, 177, **178,** 179, 308, 318, 320, 335.

Actinodictya placenta, *Hall*, 49, 100, **143,** 258, 260.

Aglithodictya numulina, *H. and C.*, **145,** 249.

Arystidictya elegans, *H. and C.*, 76, 106, **136,** 137, 142, 281, 283.

A nodifera, *H. and C.*, 76, 106, **137,** 142, 281.

Bathydorus fimbriatus, *Schulze*, 170.

Botryodictya ramosa, *Lesquereux* (sp.), 27, 40, 46, 111, 224.

B (or Tylodictya) sp., **114.**

Calathospongia amphorina, *H. and C.*, **182,** 334.

C. carceralis, *H. and C.*, **157,** 160, 300, 302, 318.

C. Carlli, *H. and C.*, 5, **158,** 159, 163, 165, 184, 302, 306.

C. (?) magnifica, *H. and C.*, **182,** 311, 312.

C. Redfieldi, *Hall* (sp.), **155,** 158, 160, 163, 165, 184, 294, 296, 306.

C. ? sacculus, *Hall* (sp.), **160,** 298.

C. Tiffanyi, *H. and C.*, **158.**

Ceratodictya annulata, *Hall* (sp.), 79, 109, **120,** 242.

C. Carpenteriana, *H. and C.*, **117,** 119, 282, 284.

C. cenieta, *H. and C.*, **120,** 280.

C. cincta, *Hall* (sp.), **118,** 242.

C. zonata, *H. and C.*, **119,** 121, 280.

Clathrospongia abacus, *Hall*, 44, **153,** 296, 306.

C. caprodonta, *H. and C.*, 123, **154,** 298.

C. (?) desmia, *H. and C.*, **125,** 248.

C. fenestrata, *Hall* (sp.), **122,** 124, 226, 248.

C. (?) Hamiltonensis, *Hall* (sp.), 36, **66,** 226.

C. (?) irregularis, *Hall* (sp.), **124,** 228.

C. (?) tomaculum, *Hall* (sp.), **123,** 124, 234, 241.

C. vascellum, *Hall* (sp.), **123,** 241, 248.

Cleodictya Claypolei, *H. and C.*, 6, **163,** 185.

C. gloriosa, *Hall*, 46, 163, **183,** 185, 192, 336, 338

C. Mohri, *Hall*, 30, 32, 46, **184,** 185, 186, 338.

Clepsydrospongia matutina, *H. and C.*, **71,** 266.

Cryptodictya Alleni, *Hall*, 49, 105, **144,** 260, 262.

Cyathodictya reticulata, *Walcott* (sp.), 25, 26, 200.

Cyathophycus reticulatus, Walcott, 23, 24, 50.

C. subsphæricus, Walcott, 24, 25, 26.

C. (Cyathodictya) reticulatus, *Walcott* (sp.), 24.

Cyathospongia Quebecensis, Dawson, 24.

Diagonella coronata, *Dawson*, 23.

D. cyathiformis, *Dawson*, 23.

Dictyophyton abacus, Hall, 121, 122.

D. Amalthea, Hall, 49, 116, 149.

D. angulatum, Larkin, 42.

D. annulatum, Hall, 42, 116, 120.

D. baculum, Hall, 81.

D. catilliforme, Whitfield, 173.

D. cinctum, Hall, 118, 119.

D. Conradi, Hall, 42, 91.

D. cylindricum, Hall, 166.

D. cylindricum, Whitfield, 166.

D. cylindricum, Larkin, 42.

D. Danbyi, McCoy (sp.), 45, 48, 63.

D. fenestratum, Hall, 42, 122.

D. filitextile, Hall, 42, 83, 86.

D. Gerolsteinensis, F. Roemer, 45, 67.

D. Halli, Hall, 125.

D. Hamiltonense, Hall, 66.

D. hastatum, Larkin, 42.

D. irregulare, Hall, 124.

D. lobatum, Larkin, 42.

D. Morini, Barrois, 147.

D. Newberryi, Hall, 42, 157, 161, 300.
D. nodosum, Hall, 42, 109.
D. parallelum, Hall, 82.
D. palulum, Hall, 77.
D. prismaticum, Hall, 83.
D. ramosum, Lesquereux, 46, **111.**
D. Randalli, Hall, 49, 129.
D. Redfieldi, Hall, 42, 155, 160.
D. rude, Hall, 42, 128.
D. *saccatum*, Hall, 160.
D. *sceptrum*, Hall, 49.
D. scitum, Hall, 49, 128.
D. serratum, Larkin, 42.
D. telum, Hall, 79.
D. tenue, Hall, 152.
D. tomaculum, Hall, 49, 123.
D. tuberosum, Conrad (sp.), 42, 43, 45, 97, 100, 112, 147.
D. vasellum, Hall, 123.
D. [Calathospongia?] saeculus, *Hall* (sp.), 46.
D. [Ceratodictya] cinctum, *Hall* (sp.), 46.
D. (Clathrospongia) abacus, Hall, 153.
D. [C.] Hamiltonense, *Hall* (sp.), 46.
D. [C.] irregulare, *Hall* (sp.), 46.
D. [Dictyospongia] cylindricum, *Whitfield* (sp.), 44.
D. [D.] Danbyi, *McCoy* (sp.), 47.
D. [D.] Morini, *Barrois* (sp.), 45.
D. [Ectenodictya] implexum, *Hall* (sp.), 44.
D. [Hydriodictya] patulum, *Hall* (sp.), 46.
D. [Phragmodictya] catilliforme, *Whitfield* (sp.), 44.
D. ? [P.] Halli, *Hall*, 49, 126.
D. [Prismodictya] baculum, *Hall* (sp.), 46.
D. [P.] parallelum, *Hall* (sp.), 46.
D. [P.] prismaticum, *Hall* (sp.), 46.
D. [P.] telum, *Hall* (sp.), 46.
D. [Tylodictya] tenue, *Hall* (sp.), 44.
Dictyophytra (?) Walcotti, *Rauff*, 50.
Dictyophytum Redfieldi, Lesley, 155.
Dictyospongia Almondensis, *H. and C.*, **76,** 85, 164, 286.
D. (?) bacteria, *H. and C.*, **77,** 275.
D. charita, *H. and C.*, **74,** 228.
D. cylindrica, Whitfield (sp.), **166,** 308, 320.
D. Danbyi, *McCoy* (sp.), 35. **63.**
D. eumorpha, *H. and C.*, **75,** 228.
D. haplea, *H. and C.*, **68,** 264.
D. lophura, *H. and C.*, **74,** 167, 228.
D. (?) Marcellia, *Clarke* (sp.), 30, 31, **65,** 139, 280.
D. Morini, *Barrois* (sp.), **147,** 290.
D. sceptrum, *Hall* (sp.), 38, 39, 72, **73,** 125, 226, 228, 230, 252, 271.
D. siraea, *H. and C.*, **75,** 282.
D. (?) stylina, *H. and C.*, **167,** 310.
D. ? (Ectenodictya?) 253.
Dictyospongia (Mastodictya) osculata, *H. and C.*, **167,** 311.
Ectenodictya ? Burlingtonensis, Hall, 164, 165.
E. eccentrica, Hall, 164, 179.
E. expansa, Hall, 154, 164.
E. implexa, *Hall*, 153, 158, **164,** 165, 306.
E. [Lyrodictya] Burlingtonensis, *Hall* (sp.), 46.
Enplectella aspergillum, *Owen*, 11, 40.
E. crassistellata, *Schulze*, 40.
Euryp'egma auricularis, *Schulze*, 142.
Farrea occa, *Bowerbank*, 187.
Gongylospongia Marshi, *H. and C.*, **92,** 93, 94, 95.
Griphodictya epiphanes, *H. and C.*, 33, 179, **180,** 309.
Hallodictya Cottoniana, *H. and C.*, 76, 106, 137, **142,** 281.
H. Sciensis, *H. and C.*, **140,** 141, 271.
Helicodictya (?) Concordia, *H. and C.*, **115,** 252.
H. (?) Scio, *H. and C.*, **116,** 252.
H. trypania, *H. and C.*, **114,** 115, 242.
Hyalostelia ? Marcellia, Clarke (sp.), 51, 65.
Hydnoceras anthracis, *H. and C.*, **109,** 203, 210, 265.
H. Avoca, *H. and C.*, 69, 100, 102, **103,** 202, 216, 218, 220.
H. Barroisi, *H. and C.*, 45, 100, **147,** 149, 299.
H. Bathense, *H. and C.*, **101,** 102, 103, 204, 214, 216.
H. botrædema, *H. and C.*, 38, **102,** 105, 109, 202.
H. eumeces, *H. and C.*, **110,** 222.
H. eutheles, *H. and C.*, **70,** 76, **105,** 137, 214, 265.
H. gracile, *H. and C.*, **70,** 264.
H. hypastrum, *H. and C.*, **105,** 212.
H. Jeumontense, *H. and C.*, **148,** 290.
H. legatum, *H. and C.*, **69,** 264.

H. Lutheri, *H. and C.*, **106**, 215.
H. multinodosum, *H. and C.*, 76, **106**, 137, 142, 276.
H. nodosum, *Halt* (sp.), **109**, 137, 202.
H. phymatodes, *H. and C.*, **104**, 148, 210, 272.
H. rhopalum, *H. and C.*, 100, **107**, 272.
H. sp., **111**, 214.
H. tuberosum, *Conrad*, 13, 16, 38, 41, 42, 69, 76, 96, **97**, 98, 99, 102, 104, 106, 107, 108, 109, 143, 202, 204, 206, 208, 210, 212, 214, 274.
H. tuberosum, Conrad,
var. glossema, *H. and C.*, 22, 81, **101**, 212, 216.
H. variabile, *H. and C.*, 79, **108**, 120, 270, 272.
Hydriodictya cylix, *H. and C.*, **78**, 120, 208, 230, 309.
H. nephelia, *H. and C.*, **79**, 241.
H. patula, *Hall* (sp.), **78**, 100, 206.
Hyphantænia Chemungensis, *H. and C.*, **139**, 254, 256, 288.
Lebedictya crinita, *H. and C.*, **169**, 170, 314, 316, 320.
Lyrodictya (?) Burlingtonensis, *Hall* (sp.), **165**, 305.
L. Romingeri, *Hall*, 6, 46, **170**, 171, 310.
Lysactinella Gebhardi, *Girty*, 64.
L. perelegans, *Girty*, 64.
Mastodictya osculata, *H. and C.*, 16, 30, 167, 168, 311.
Oucosella catinum, *Rauff*, 126.
Palythoa fatua, 21, 22.
Phragmodictya catilliformis, *Whitfield* (sp.), 30, 32, 134, 172, **173**, 174, 175, 176, 177, 181, 309, 326, 328, 330, 332, 334.
P. (?) crebristriata, *Hall*, 44, **176**, 320.
P. eccentrica, Hall, 179.
P. expansa, Hall, 154.
(?) P. lineata, *Hall*, 44, **176**, 334.
P. Newberryi, Hall, 161.
P. patelliformis, *Hall*, 44, **176**, 328.
P. ? Redfieldi, Hall, 155.
P. scyphus, Hall, 44, 173.
P. [Aclœodictya] eccentrica, *Hall* (sp.), 44.
P. [Thysanodictya] expansa, *Hall* (sp.), 44.
Physospongia alternata, *Hall*, 44, **195**, 323.
P. Colletti, *Hall*, 32, 46, 171, 188, 189, 190, 192, **193**, 194, 195, 324.
P. Dawsoni, *Whitfield* (sp.), 31, 171, 188, **189**, 190, 191, 192, 193, 194, 195, 196, 197, 322.
P. multibrsaria, *H. and C.*, 188, **196**, 321.
Prismodictya Allegania, *H. and C.*, **84**, 238.
P. amicitiæ, *H. and C.*, **87**, 270.
P. aulophia, *H. and C.*, **88**, 239, 266, 280.
P. baculum, *Hall* (sp.), **81**, 85, 234.
P. banano, *H. and C.*, **87**, 232.
P. cercidea, *H. and C.*, 88, **89**, 90, 238, 282.
P. choanea, *H. and C.*, **85**, 86, 164, 236, 253, 268.
P. cithara, *H. and C.*, 88, 89, **90**, 268, 270.
P. Conradi, *Hall* (sp.), 81, **91**, 95, 234, 236.
P. corynia, *H. and C.*, 85, **86**, 233.
P. filitextilis, *Halt* (sp.), **86**, 240, 252.
P. uarthecia, *H. and C.*, **90**, 268.
P. palæa, *H. and C.*, **69**, 264.
P. parallela, *Hall* (sp.), 81, **82**, 84, 236, 238, 240, 268.
P. polyhedra, *H. and C.*, **168**, 306.
P. prismatica, *Hall* (sp.), **83**, 84, 116, 232, 240.
P. cf. prismatica, 282.
P. ptionia, *H. and C.*, **88**, 89, 90, 266.
P. spectabilis, *H. and C.*, **82**, 238.
P. sp.?, 271.
P. telum, *Hall* (sp.), 22, **80**, 87, 88, 232, 268, 282.
Protospongia coronata, *Dawson*, 23.
P. delicatula, *Dawson*, 25.
P. mononema, *Dawson*, 23.
P. rheuana, *Schlüter*, 49, 68.
P. tetranema, *Dawson*, 23.
Rauffella filosa, Ulrich, 48
Rhabdosispougia Amalthea, *Hall* (sp.), **116**, 230.
R. Condroziana, *H. and C.*, **149**, 292.
Rœmerispongia Gerolsteinensis, *F. Roemer* (sp.), 35, **67**, 189.
Sphærodictya subsphærica, *Walcott* (sp.), 200.
Teganium subsphæricum, Walcott (sp.), 24, 25, 26.
Tetragonis Danbyi, McCoy, 41, 43, 45, 63, 64, 72.
T. Eifelensis, F. Roemer, 43.
T. Murchisoni, *Eichwald*, 43, 45, 72.
T. [Prismodictya] Eifelensis, *F. Roemer* (sp.), 45, 67.
Thamnodictya Newberryi, *Hall*, **161**, 162, 298, 302.
T. Ortoni, *H. and C.*, **162**, 304.
Thysanodictya apleta, *H. and C.*, **135**, 250, 253.

T. Edwin-Halli, *H. and C.*, 38, **126**, 128, 131, 155, 246.
T. expansa, *Hall*, (sp.), **154**, 304.
T. hermenia, *H. and C.*, **133**, 134, 253, 276, 278.
T. Johnstoni, *H. and C.*, **130**, 244.
T. porcilus, *H. and C.*, **127**, 157, 246.
T. quasillum, *H. and C.*, **131**, 133, 274.
T. Randalli, *Hall* (sp.), 125, **129**, 132, 246.
T. rudis, *Hall* (sp.), 125, 127 **128**, 129, 130, 131, 132, 155, 237, 244.
T. saccus, *H. and C.*, **130**, 248.
T. scyphina, *H. and C.*, **132**, 283.
T. turricula, *H. and C.*, **135**, 274.
Tylodictya Warrenensis, *H. and C.*, **151**, 152, 153.
T. (?) tenuis, *Hall* (sp.), **152**, 304.
Uphantænia Chemungensis, Vanuxem, 13, 42, 137, 139.
U. Dawsoni, Whitfield, 44, 189, 191.
U. [Hyphantænia] Chemungensis, *Vanuxem* (sp.), 41.
U. [Physospongia] Dawsoni, *Whitfield* (sp.), 44, 48.
Walteria Flemmingi, *Schulze*, 142.

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